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PARK UNIT SHELVES

Big South Fork National River and Recreation Area

Phase III
Progress Report

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TABLE OF CONTENTS

page

TABLE OF CONTENTS ii

I. BEST MANAGEMENT PRACTICES FOR ABATEMENT OF MINE DRAINAGE 1
- A. CONTROL AT SOURCE 1
    - 1. Site Reclamation 1
    - 2. Water Source Control 2
    - 3. Mine Seals 2
    - 4. Subsurface Injection 3
    - 5. Bacterial Inhibitor Application 6
- B. TREATMENT OF MINE DRAINAGE 6
    - 1. Chemical Treatment Systems 6
    - 2. In Stream Alkaline Addition 7
    - 3. Innovative Passive (Wetland) Treatment 8
- C. IMPLICATIONS OF TOXIC METALS ON SELECTION OF REMEDIATION BMP 11

II. REMEDIATION EVALUATION FOR PRIORITY SITES 14
- A. LAUREL BRANCH CREEK SITE 14
    - 1. Remediation Recommendations 17
    - 2. Conceptual Design 19
    - 3. Construction Costs 19
- B. DEVILS CREEK SITE 21
    - 1. Remediation Recommendations 23
    - 2. Conceptual Design 25
    - 3. Construction Costs 27
- C. WORLEY MINE #86 SITE 28
    - 1. Remediation Recommendations 30
    - 2. Conceptual Design 32
    - 3. Construction Costs 34

III. REFERENCES 36

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I. BEST MANAGEMENT PRACTICES FOR ABATEMENT OF MINE DRAINAGE

Two different approaches can be employed to abate CMD from abandoned mine land sites that impact receiving surface waters. The two approaches are:

- Prevention and/or control of CMD formation, and
- Treatment of CMD at its discharge point or in the receiving stream.

Best management practices (BMPs) used to prevent and/or control CMD generation at its source are based on approaches that will minimize water, exclude air (oxygen), buffer the CMD formation reactions and/or isolate or remove acid producing materials. CMD treatment BMPs are used to neutralize the acidity and precipitate metals in the CMD once it has already formed. Selection of the most appropriate BMP or combination of BMPs varies with each abandoned mine land site and CMD discharge encountered.

A. CONTROL AT SOURCE

Various methods have been developed and used historically that successfully control CMD generation at abandoned mine land sites. CMD source control measures can be grouped in a number of categories. Specific techniques within each of these categories are identified and discussed below.

1. Site Reclamation

Site reclamation is commonly used for abandoned mine sites that have been left unworked and were not fully closed following coal extraction or disposal. Typically, these sites were mined prior to passage of the state and federal surface mining laws; recent sites involve bankruptcy and/or bond forfeitures of permitted sites. These types of sites are typically left ungraded and vegetated, and have poor drainage. In the BISO the sites fall in the category of abandoned deep mine sites. The sites contain varying amounts of open spoil which typically are comprised of coal refuse discarded along the Big South Fork and its tributaries from up slope deep mine entries.

Grading and Revegetation - Grading and revegetation are common reclamation techniques used in combination to address abandoned mine lands and can have positive effects on CMD quantity and quality. Grading activities are intended to return sites to previous topography or create stable slopes which when used in combination with interceptor channels can aid in directing stormwater from the site. Revegetation of mine sites often involves soil amendments (e.g., fertilizers, limestone and biosolids) to provide conditions for rapid plant growth and soil development. This can also aid in minimizing CMD production by increasing evapotranspiration losses, decreasing air input to the spoil/refuse and adding buffering to infiltrating waters.

Remining - Remining is a technique employed where shallow underground mines, abandoned surface mines and coal refuse piles are reopened, using surface mining techniques, to extract remaining coal resources. Coal and coal by-products are frequently a significant contributor to CMD formation in these sites. By removing these materials and reclaiming the site with the above techniques, remining can substantially reduce CMD production, and result in reduced infiltration and pyrite oxidation. This technique is likely to be inappropriate for the BISO due the depth of the overburden and the location of the mines within a National Park.

2. Water Source Control

Water source control BMPs are measures that are employed to keep water from contacting and infiltrating acid generating materials on abandoned mined lands thereby preventing and/or reducing CMD discharges. Water source control BMPs include:

Diversion/Isolation of Water - Diversion/isolation of water techniques prevent surface waters (e.g., streams) from entering or contacting underground mines (where stream flow enters into a deep mine complex), mine spoil and/or mine refuse. The methods employed involve new stream channel construction, stream channel lining, retaining wall construction, contact surface lining and stream bed grouting.

Stormwater Interception - Stormwater interception is commonly employed with site reclamation, but can be employed separately, for water control on abandoned surface mines and mine refuse spoil. Channels are constructed up slope of the acid producing areas and/or at various intervals on the specific site to collect and channel stormwater runoff from a site. This approach prevents the water from infiltrating into the mine spoil and/or mine refuse were it can contact acid-producing minerals and produce CMD, thereby reducing the volume and possibly the improving the quality of the CMD. Stormwater interception also decreases erosion of materials (e.g., coal refuse) from the site preventing sedimentation of unwanted and potentially toxic material from entering surface waters.

Barriers - Barriers are normally placed on top of mine spoil or refuse materials to prevent precipitation and air from contacting the mine spoil and refuse material. This will prevent CMD formation by removing agents that are needed for the acid-producing reactions. Materials used to create barriers are typically geo-synthetic materials or natural soil materials, such as compacted clay soils. Grouting barriers have been employed to create a vertical barrier (e.g., along a highwall) preventing lateral movement of groundwater into the mine spoil and refuse. A grout barrier is created by injecting the grout, as a liquid, in regularly space bore holes along vertical face.

3. Mine Seals

Mine seals are used to exclude passage of air to the deep mine preventing oxygen from contacting acid-producing minerals where CMD can be produced. They are also used to prevent

or control the flow of water at deep mine openings. Mine seals can be either dry or wet and are used for sealing slope entries, drift entries, shafts, and boreholes that are opened to deep mine workings. They are often constructed as a safety precaution to prevent entrance to abandoned mines by individuals and to control the escape of methane gas.

Dry Seals - Dry seals are placed in openings to prevent air and water passage into the mine. These seals are suitable for openings where there is no discharge water flow that can result in hydrostatic pressure and failure (blow-out) of the mine seal. Dry seals are often constructed on vertical shafts that were built into mine workings to provide ventilation and access. An example of a typical vertical shaft dry seal is attached as Figure 1.

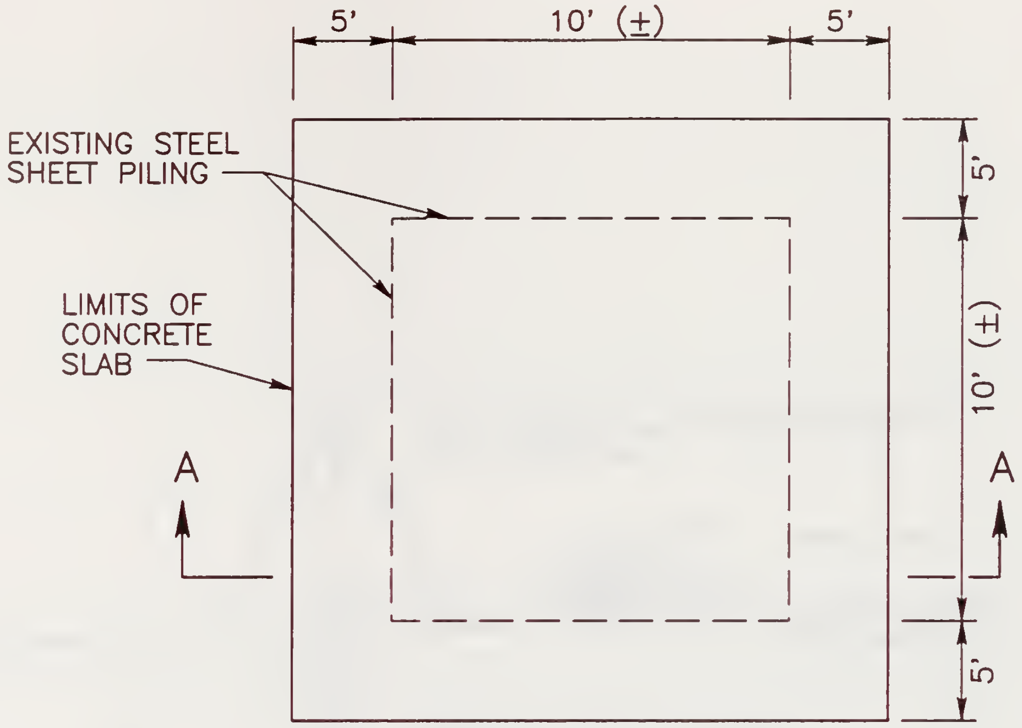
Wet Seals - Wet seals are designed to prevent the passage of air into the mine while allowing normal mine discharge to flow through the discharge outlet. The discharge outlets in the wet seal are provided with air traps to prevent inflow of air. Wet seals can also be designed to control the discharge flow from a mine opening and are often used in combination with treatment systems.

Hydraulic Wet Seal - A variation to the wet seal is a hydraulic seal which prevents air and water flow in either direction. The intent of the hydraulic seal is to flood the mine workings saturating the acid-producing materials in an anoxic environment, thereby reducing the formation of CMD and preventing it from discharging from the mine workings. Failure of a hydraulic seal can result in catastrophic impacts to receiving waters and could potentially be a safety hazard. As a result, this seal is only a viable alternative where hydraulic pressures are nominal (e.g., less than 50 feet).

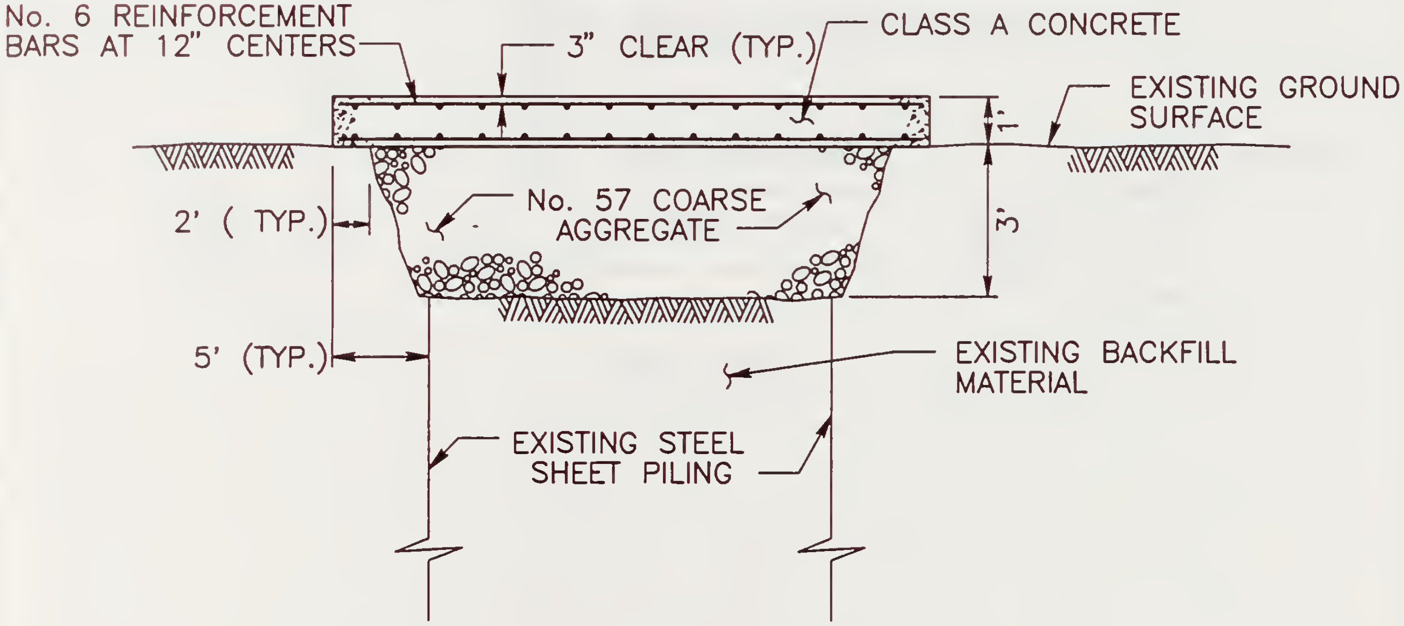
4. Subsurface Injection

Subsurface injections are used in underground mines, spoil materials and refuse piles. Typical uses are as follows:

Deep Mine Injection - Surface subsidence of abandoned mines is typically stabilized by injection of cementacious materials at the mine level to fill mine voids. Injected materials will often prevent subsidence and has recently been found to inhibit CMD production. Fly ash is often used for this purpose because of its relatively low cost, flowability, natural pozalonic properties and alkaline characteristics. Filling of the mine void will provide support to the overburden, act as hydraulic barriers to flow in the mine, and add alkalinity to contact water. In certain conditions, injection of concrete and limestone gravel columns is employed for roof support of the mine from the surface through boreholes; a typical detail for deep mine injection is provided in Figure 2. The technique is currently under investigation for its potential water quality benefits because of the reactivity of the highly alkaline injection material with water in the deep mine complex, thereby inhibiting CMD production and/or neutralizing CMD in the deep mine pool.



PLAN
(N.T.S.)



SECTION AA
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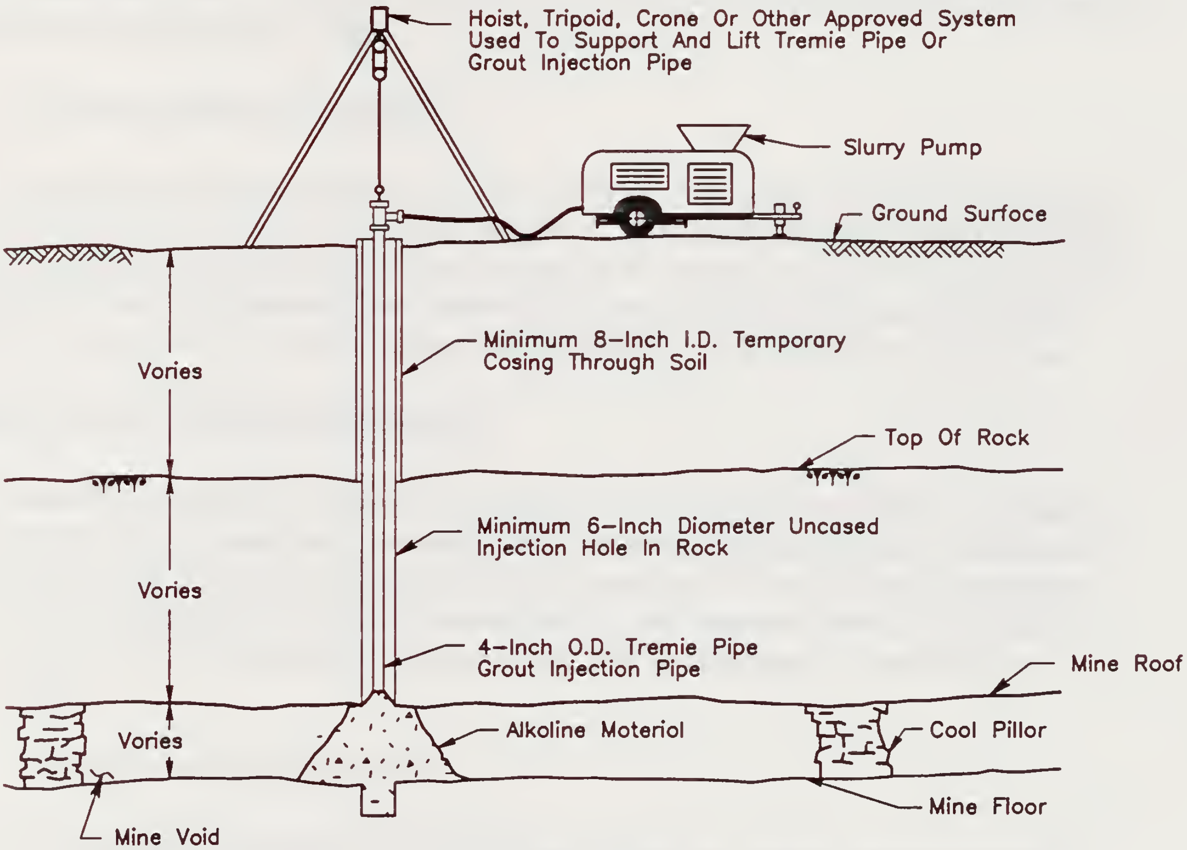
BIG SOUTH FORK NATIONAL RIVER
RESTORATION STUDY

ABANDONED VERTICAL SHAFT
DRY SEAL

NO SCALE

FIGURE


Hoist, Tripoid, Crane Or Other Approved System Used To Support And Lift Tremie Pipe Or Grout Injection Pipe
Slurry Pump
Ground Surface
Varies
Minimum 8-Inch I.D. Temporary Casing Through Soil
Top Of Rock
Minimum 6-Inch Diameter Uncased Injection Hole In Rock
Varies
4-Inch O.D. Tremie Pipe Grout Injection Pipe
Mine Roof
Varies
Alkaline Material
Coal Pillar
Mine Floor
Mine Void

NOT TO SCALE

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ALKALINE INJECTION FOR
MINE DRAINAGE STABILIZATION

NO SCALE

FIGURE

Overburden Grouting - Pressurized grouting of rock and soil overburden can be performed to consolidate materials and fill fractures. Overburden grouting can provide additional stability to the overburden, but is primarily used to limit groundwater flow and prevent infiltration. Overburden grouting can be performed using various cement or chemical grouts, depending on applications and conditions.

Toxic Material Encapsulation - Fly ash or other materials can also be injected into mine spoils and refuse materials to encapsulate pockets containing high acid-producing materials. This will reduce acid output by buffering the pyrite oxidation reactions and inhibiting water from contacting the acid-producing minerals.

5. Bacterial Inhibitor Application

Bacterial inhibitors can be applied to mine spoil to lower acid production by killing the bacteria *(Thiobacillus ferroxidans)* known to be critical in the catalytic pyrite oxidation process. The bacterial inhibitors include bactericides, detergents and organic sludge. This technique is most frequently used in situations where immediate control of CMD formation is important. This BMP is temporary and without frequent application the CMD formation will reoccur.

B. TREATMENT OF MINE DRAINAGE

Treatment of mine drainage can be used solely or in conjunction with site reclamation BMPs, if reclamation is inadequate to eliminate the production of mine drainage. Treatment of mine drainage can be either active (typically chemical treatment) or passive and are typically employed on the discharge, but may also be employed on the impacted stream. The various types of treatment BMPs that may be employed to address the discharges in the BISO are discussed below.

1. Chemical Treatment Systems

Conventional chemical treatment systems use mechanical feeders, mixers and settling basins in various combinations to provide CMD treatment. Different chemicals are used for treatment in these systems depending on various factors such as water chemistry, effluent requirements, handling and material costs, site conditions and treatment duration. Systems are typically classified based on the chemical used for treatment. Four chemicals are typically used in treating CMD: calcium carbonate (limestone), calcium hydroxide (hydrated lime), sodium carbonate (soda ash or briquettes) and sodium hydroxide (caustic soda). Anhydrous ammonia is also being used to a limited extent to treat CMD. The four typical treatment chemicals can be evaluated by their basic components, i.e. calcium vs. sodium and carbonate vs. hydroxide.

Calcium vs. Sodium - Calcium compounds are typically less expensive than sodium compounds, but have slower reaction rates. They are also easier to handle and require few safety precautions. Subsequently, they are usually used in large treatment systems along with aeration

and mixing units. Conversely, sodium compounds are very reactive and typically used in short term applications or remote locations.

Carbonate vs. Hydroxide - The pH of the water during treatment has a significant role in the effectiveness of a particular chemical compound for CMD treatment. Carbonate compounds can be limited in their ability to raise the pH of water to sufficiently neutralize acidity and precipitate metals. Hydroxides can easily raise the pH of treated water to 12 or higher. Subsequently, over application of these compounds is easy and can often produce an unwanted situation. The relationship between pH and the occurrence and precipitation of most metals in CMD affected waters will often dictate the choice of the chemical used.

2. In Stream Alkaline Addition

In stream alkaline addition systems are relatively new treatment techniques in which limestone aggregates are used to provide slurry dosing directly to CMD affected streams. These systems are usually designed to provide only alkalinity addition to neutralize acidity in affected waters. These systems typically do not provide for metal removal.

Diversion Well Systems - The diversion well is a limestone dosing system designed to add alkalinity through a fluidized bed of limestone. Fluidization occurs through a cylindrical well filled with crushed limestone aggregate that receives water through an influent pipe at the bottom of the well. The influent water has sufficient head to rise upward through the well, fluidizing the aggregate and forcing abrasion and dissolution of the limestone. Water from the well is then discharged over the lip of the well and back to the source. Head is provided by constructing an impoundment upstream from the well and diverting water through a pipe to the base of the well.

Rotary Drum Systems - Rotary drum limestone slurry dosers are water powered cylindrical containers filled with limestone aggregate. The water for the system is diverted from the stream and rotates the drums where the limestone is ground and mixed into a fine slurry. The slurry is then reintroduced and mixed with the stream water. The system can be adjusted to maintain dosing and water quality goals during various levels of flow, however, design and operation can be limited by minimum flow requirements (depending on the amounts of limestone and number of drums used). The system also requires construction of an impoundment on the watercourse.

Limestone Fine Dosing - Limestone fine dosing is a relatively new and inexpensive treatment method that arose from the drum system technology. The system uses sand sized limestone particles that are "dumped" into streams at strategic points in affected watersheds. The fines are then carried through the stream course and mixed in with the stream substrate. Since trucks are used to transport the limestone to the application sites, this treatment type requires good access and roads in a treatment area. Given the dynamic and unpredictable nature of stream flows, it is unclear if limestone fines can provide consistent, long term neutralization in CMD

affected streams. Limestone fines would have to be applied at least once per year, possibly more frequently.

3. Innovative Passive (Wetland) Treatment

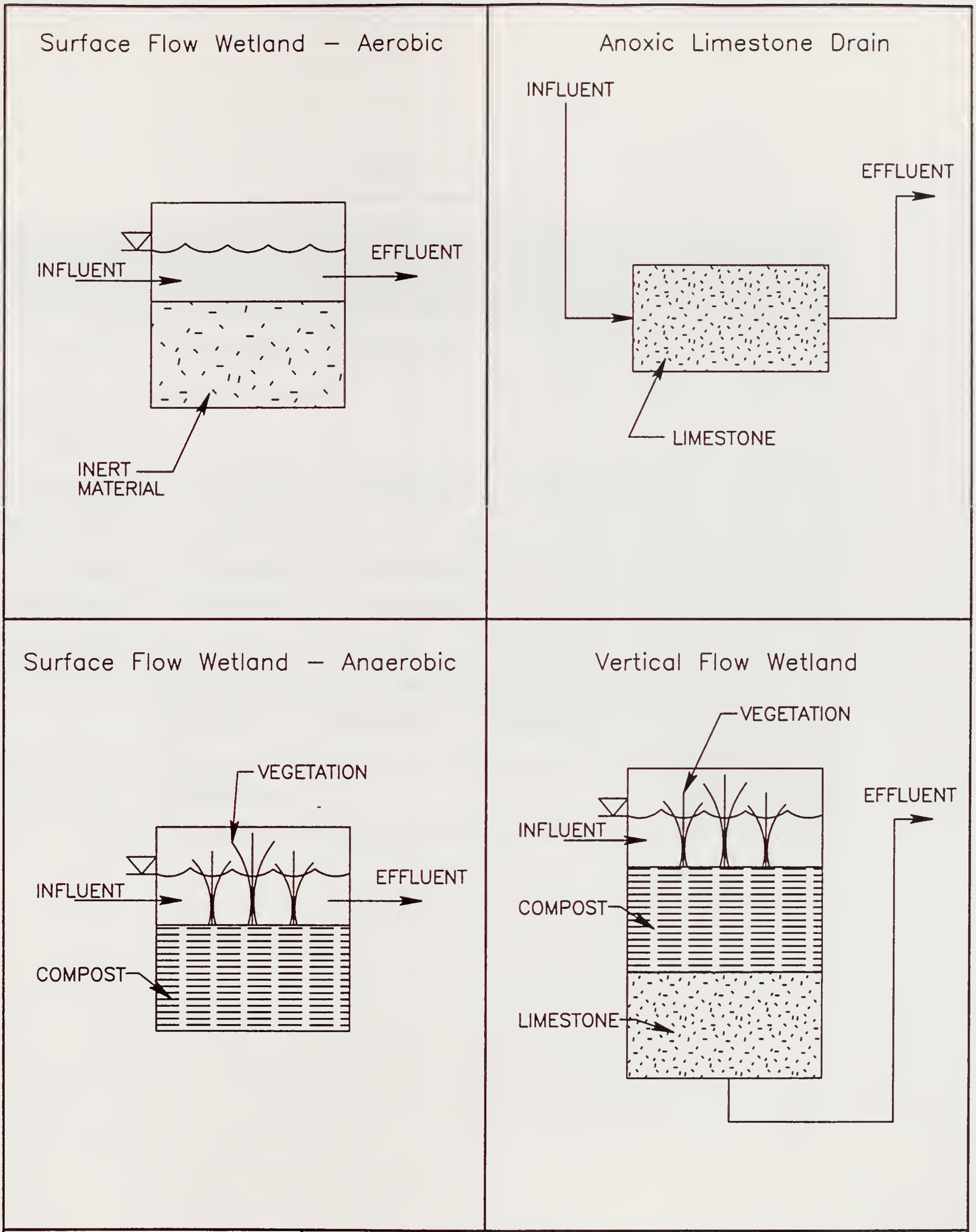
Passive systems for the treatment of CMD represent a number of viable treatment technologies which have been developed within the last fifteen years. Passive systems use a variety of substrates, plants, and hydraulic/hydrologic designs to remediate mine drainage via a number of chemical (e.g., precipitation, oxidation, and hydrolysis) and biological processes (e.g., microbial oxidation and reduction). The various passive treatment designs are capable of reducing metals (e.g., aluminum, iron, manganese and trace metals) and/or acidity from the mine drainage. Subsequently, these systems can provide long term, low maintenance treatment and stream restoration.

Four passive treatment methods are typically appropriate for consideration with mine drainage discharges. These methods are the aerobic surface flow wetlands, anaerobic surface flow wetlands, vertical flow wetland and anoxic limestone drain. A brief description of each system is provided below. Figure 3 provides a schematic profile and Table 1 lists the design limitations of each system.

Aerobic Surface Flow Wetlands - Aerobic surface flow wetlands are systems normally employed to oxidize, hydrolyze and precipitate metals (e.g., iron and manganese) from alkaline mine waters. This type of system has also been successful at decreasing metals in acidic mine drainage; although rates of removal require substantially larger surface areas. Aerobic wetlands employed by Brodie (1991) contain open water and emergent vegetation (e.g., cattails and rushes) planted in inert soils. Recently constructed systems evaluated by Hedin et al. (1994) and by Dietz (1993) have employed inert stone as the only substrate and have been successful at removing manganese in alkaline discharges and iron from acidic mine waters.

Anaerobic Surface Flow Wetlands - Anaerobic surface flow wetlands are systems that have been successful at removing metals (i.e., aluminum and iron), similar to aerobic surface flow wetlands, and have also had limited success at reducing acidity from mine waters (Hedin et al. 1994; and Dietz et al. 1994). Anaerobic surface flow wetlands contain an organic substrate (e.g., spent mushroom compost) planted with emergent vegetation and variable standing water from one inch to one foot. A number of processes including oxidation, sulfide precipitation, hydrolysis, and absorption have been suggested as being important in metal removal within this type of system. Microbial sulfate reduction has been identified as the principal process producing alkalinity.

Vertical Flow Wetlands - Vertical flow wetlands, also known as alkalinity producing systems, are a relatively recent development in passive treatment technology to remediate acidic mine waters. This type of wetland has achieved substantial acidity removal and alkalinity production for applications in highly acidic (greater than 200 mg/L as $CaCO_3$)mine waters (Dietz



Surface Flow Wetland – Aerobic

Anoxic Limestone Drain

Surface Flow Wetland – Anaerobic

Vertical Flow Wetland

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RESTORATION STUDY

SCHEMATIC PROFILES OF
PASSIVE TREATMENT SYSTEMS

NO SCALE

FIGURE

Table 3
Limitations of Passive Treatment Systems

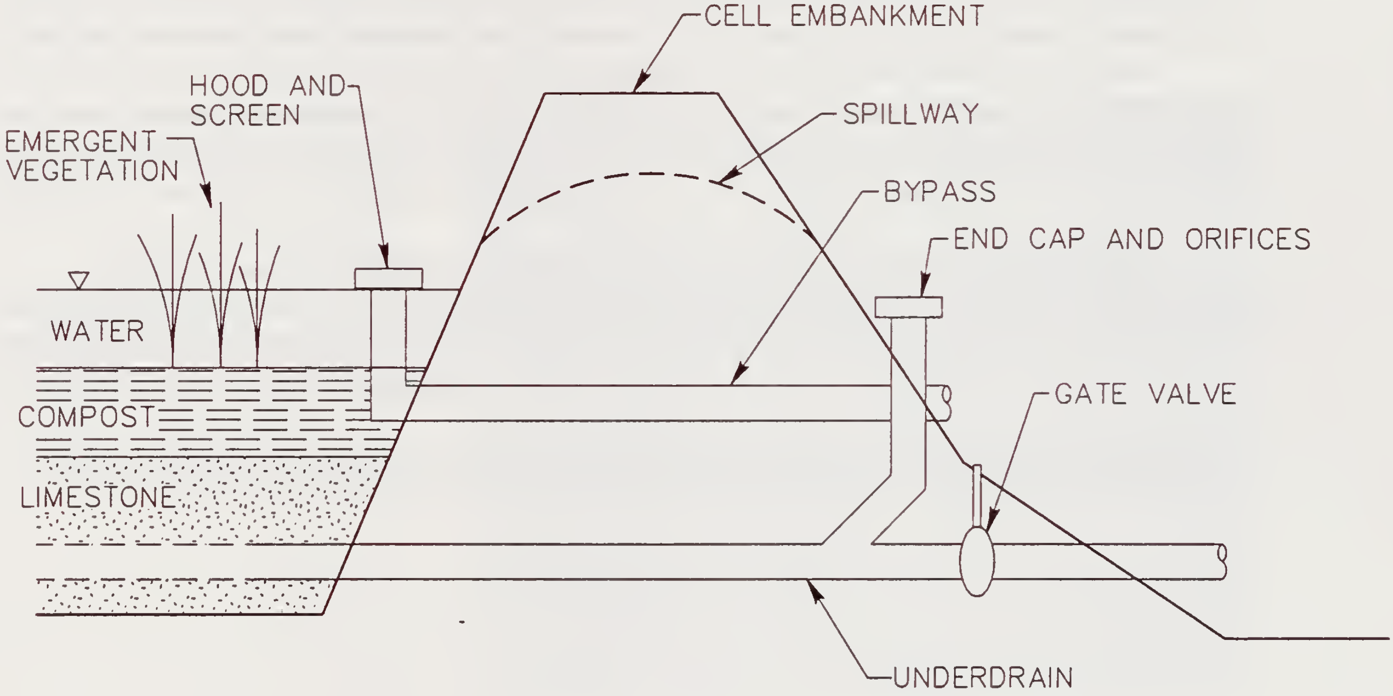
Physical Parameter	Treatment Type			
	Aerobic Surface Flow Wetland	**Anaerobic Surface Flow Wetland**	**Anaerobic Vertical Flow Wetland**	**Anoxic Limestone Drain**
Flow (cfs)	Size Dependent	Size Dependent	Size Dependent	<0.5
pH	>4	>3	NA	<5
Dissolved Oxygen (mg/l)	>2	NA	NA	<2
Acidity (mg/l)	< Alkalinity	Size Dependent	Size Dependent	<100
Alkalinity (mg/l)	> Acidity	NA	NA	NA
Ferric Iron (mg/l)	Size Dependent	Size Dependent	< 30	<2
Total Iron (mg/l)	<70 (w/o aeration)	Size Dependent	< 30	NA
Aluminum (mg/l)	NA	NA	NA	<5
Site Characteristics	Gently sloping site with very large treatment area.	Gently sloping site with very large treatment area	Gently sloping site with medium to large treatment area	Moderately to steeply sloping site with long, narrow treatment area
Other Comments	Influenced by seasonal changes			Additional basin required for metal precipitate removal

and Stidinger 1996; and Kepler and McCleary 1994). This wetland design has also been successful in removing iron and aluminum from highly acidic mine waters. Vertical flow wetlands consist of an organic substrate layer (e.g., spent mushroom compost) placed over a limestone layer. An underdrain piping system placed beneath the limestone layer collects the water that has passed through the substrate layers. The systems can be provided with a bypass system which allows medium to large flows to bypass the underdrain system and mix with treated waters later in the system. Vertical flow wetlands may or may not be planted with emergent vegetation and contain standing water from less than one, to greater than three feet. Processes previously mentioned for anaerobic surface flow wetlands, as well as limestone dissolution, have been identified as important mechanisms of mine water remediation in vertical flow wetlands. A typical section of a vertical flow wetland embankment and bypass system is provided as Figure 4.

Anoxic Limestone Drains - Anoxic limestone drains (ALDs), have been used almost exclusively in remediating CMD. ALDs studied by Hedin et al. (I 994) and Brodie et al. (1 99 1) have produced substantial alkalinity which is important in neutralizing acidity and in the hydrolysis and precipitation of iron and aluminum, although ferric iron (greater than 2 mg/L) and aluminum (greater than 5 mg/L) have been found to be detrimental to the long term performance of ALDS. The systems consist of trenches or basins filled with limestone that are sealed and buried to prevent oxygenation of the mine drainage that can cause armoring of the limestone and/or clogging of the ALD. Mine drainage passes through the trench or basin where calcium carbonate is solubilized from the limestone producing the alkalinity responsible for neutralization of mine water acidity and precipitation of iron and aluminum. ALDs are typically used in combination with aerobic and anaerobic surface flow wetlands which hydrolyze and precipitate iron from the CMD.

C. IMPLICATIONS OF TOXIC METALS ON SELECTION OF REMEDIATION BMP

The presence of toxic metals (e.g., copper and zinc) in a number of the CMD discharges located in the BISO will have implications on selection of the remediation method, particularly where treatment will be required. Control at source BMPs (discussed above in Section A) can have effects on the quantity of toxic metals discharged through reduction in CMD discharge flow and/or decreases in the CMD strength. Incremental decreases in CMD flow would likely have corresponding decreases in toxic metal loading to the Big South Fork unless the CMD strength increased proportional to the decrease in flow. Decreases in CMD strength (i.e., pH and acidity) will also likely result in a corresponding decrease in concentrations of toxic metals because low pH and high iron and aluminum are the likely causes of trace metal solubilization from contact minerals. However, quantifying the toxic metal loading decreases associated with control at source BMPs is not possible because changes in CMD flow and strength are not quantifiable for this type of remediation method and no studies have been conducted regarding the effect of remediation on trace metal concentrations.



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RESTORATION STUDY
VERTICAL FLOW WETLAND
CONCEPTUAL TREATMENT CELL
EMBANKMENT CROSS SECTION

NO SCALE

FIGURE

Trace metal removal has been documented for active chemical treatment systems where the pH is increased with chemical agents such as sodium hydroxide (Watzlaf 1988). The majority of trace metals (copper, zinc and chromium) will co-precipitate with iron oxides as the pH approaches neutrality. Some trace metals (e.g., nickel) were found to required pHs above 8 for complete precipitation. If nickel is the metal of concern for a CMD discharge then chemical agents (e.g., NaOH) would be required to achieve this elevated pH.

Trace metal removal in wetland treatment systems has been documented by a number of investigators. Eger and Lapakko (1989) found natural wetlands to reduce concentrations of nickel by 80 percent and copper to less than detection in mine drainage from tailings and stockpiles associated with a steel mining operation. In a subsequent project, Eger *et al.* (1994) found a constructed wetland treatment system to successfully lower nickel, copper, cobalt and zinc from a neutral mine drainage. In a laboratory study using wetland sediments, Fyson *et al.* (1994) reported enhanced arsenic and nickel removal in sediments amended with organic substrates which was related to reducing conditions. In a recent study, Sikora *et al.* (1996) found pilot-scale SAP units (similar to anaerobic vertical flow wetlands) to effectively remove copper, nickel, lead and zinc as sulfides, typically greater than 99 percent reductions.

Based on this information it is likely that the anaerobic vertical flow wetland will successfully lower trace metal concentrations from CMDs in the BISO. However, actual effluent concentrations are not likely to be quantifiable because literature on design guidance and field-scale performance are not available.

---WILL DEVELOP THIS SECTION IN GREATER DETAIL FOR FINAL REPORT--- ✓

II. REMEDIATION EVALUATION FOR PRIORITY SITES

The reconnaissance and monitoring program identified a number of priority sites contributing water quality impacts on the Big South Fork. A GPS study was conducted at each of the priority sites to determine areas where the point or multi-point source discharges can be treated or the extent of mine spoil generating the diffuse mine drainage. Figure 5 shows the locations of the priority sites in the BISO and the GPS surveyed areas.

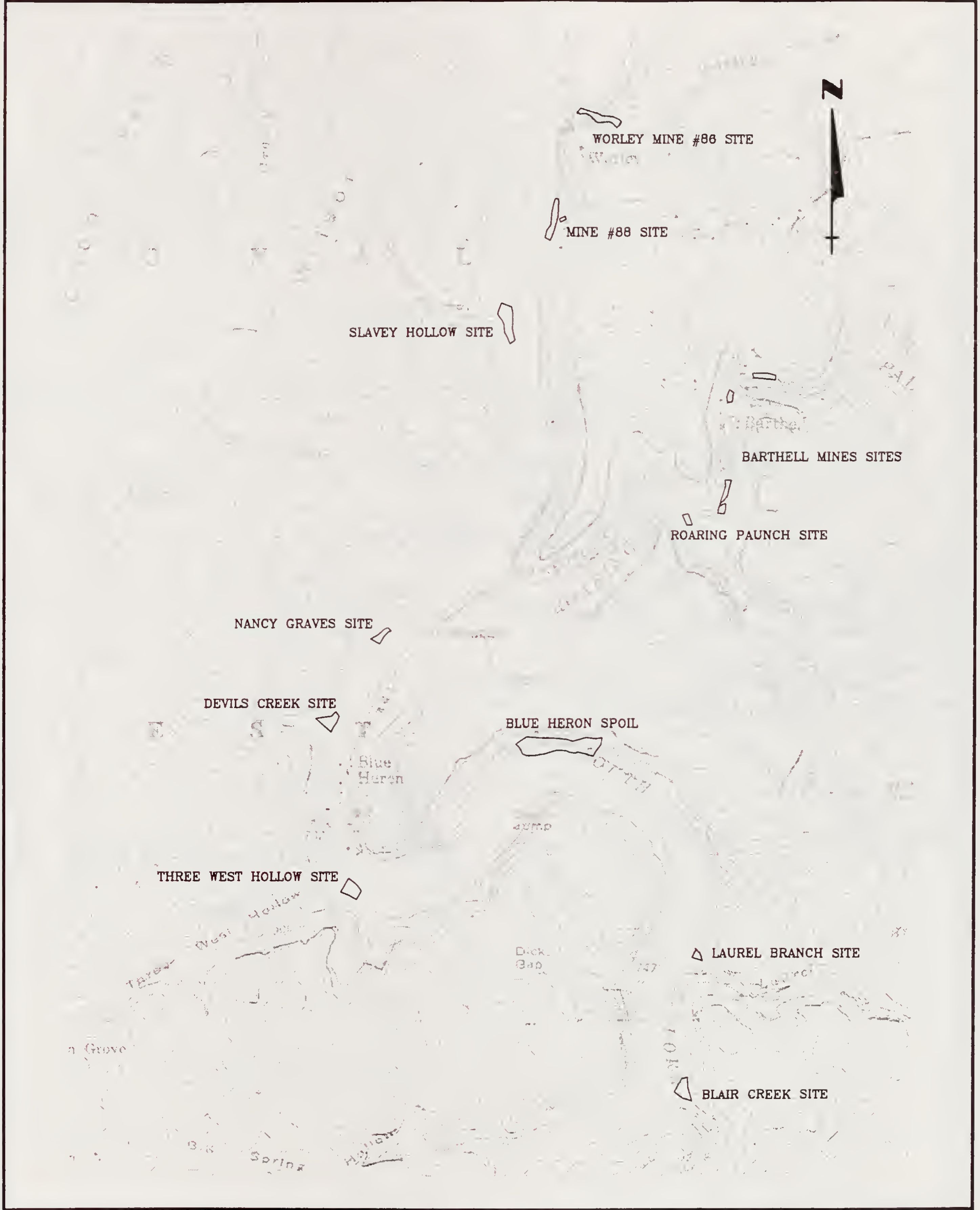
Three of the locations have been evaluated (to date) for remedial actions to address the water quality impacts of the priority sites. The Laurel Branch, Devils Creek and Worley Mine #86 sites are discussed below.

A. LAUREL BRANCH CREEK SITE

The Laurel Branch Creek site is located near the southern border of the BISO (see Figure 5). The Laurel Branch Creek contributes pollutants to the BISO and are from diffuse discharges associated with mine spoil from historic deep mining on the side slope of the watershed. The mine spoil from this mining, depicted in Figure 6, is located down slope of a mine opening and includes a large section of the stream channel. In - fact, this mine spoil has created a waterfall on the Laurel Branch that is approximately 20 feet in height (see Plate 1).

Plate 1. Mine spoil, waterfalls and associated CMD discharges on the Laurel Branch Creek.

Water quality data at the mouth of the Laurel Branch from the Phase I and II monitoring program indicate pH varies from 3.5 to 5.5 and appears to be related to stream flow with low pHs occurring during low flows. Acidity, aluminum, iron, manganese and zinc are also related to discharge flow with higher concentrations occurring at lower flows. Phase I sampling also included an upstream station (i.e., above the mine spoil) which contained water quality reflecting the absence of mine drainage impacts; the upstream water quality had a pH greater than 6, conductivity less than 50 μmhos/cm, and sulfate less than 10 mg/L. The monitoring results suggest the source of the CMD to the Laurel Branch is the mine spoil.



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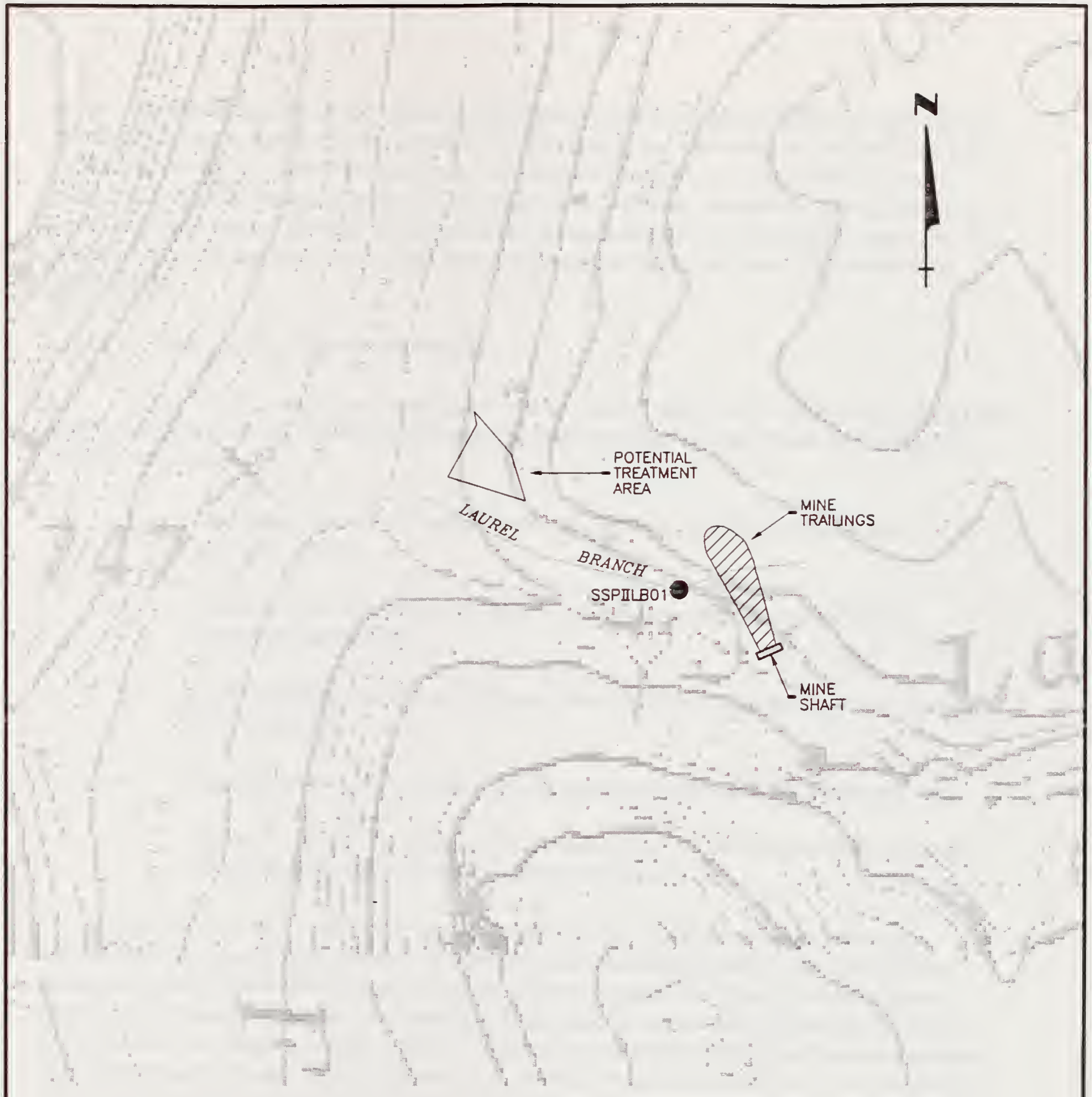
RESTORATION STUDY

PROJECT LOCATION MAP

SCALE
1'=2000'

FIGURE



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LAUREL BRANCH SITE

SITE CHARACTERISTICS

SCALE
1'=300'

FIGURE

Examination of the mine spoil and man-made waterfall indicated CMD was emanating at several locations at the base of the waterfall. This suggests that upstream, uncontaminated water infiltrates into the mine spoil located in and adjacent to the stream channel where this water reacts with the acid-forming minerals of the mine spoil. The flow dependent water quality at the mouth supports this conclusion because the infiltration capacity of the mine spoil represents only a small portion of the total flow at high flows but increases in proportion as the stream flow decreases.

1. Remediation Recommendations

A number of possible site remediation and treatment BMPs are available for resolving the water quality impacts on the Big South Fork associated with the Laurel Branch discharge. The BMPs identified include:

- Instream treatment of Laurel Branch using active treatment systems (e.g., chemical dosers);
- Instream treatment of Laurel Branch using passive treatment systems (e.g., limestone sand dosing);
- CMD discharge treatment using passive wetland treatment systems (e.g., vertical flow wetlands);
- Elimination of CMD source areas via removal of mine spoil from the site; and
- Reduction of CMD production by construction of a stable lined stream channel to minimize infiltration of stream into the mine spoil.

Most of the active treatment systems available require a high degree operation and maintenance to sustain treatment, such as electricity and chemical feeding. The rotary-drum system is a lower maintenance (requires no electricity and manual feed once every one to two weeks) active treatment that has been successfully employed to treat CMD impacted streams in West Virginia, but requires a minimum of 0.1 cfs to operate which is not present on a continuous basis in the Laurel Branch Creek (Zurbuch *et al.* 1996). Long term operation records for many of the active treatment systems indicate mechanical failures occur resulting in loss of treatment and water quality impacts on the receiving stream biota. Instream treatment also results in precipitation of metals (primarily iron and aluminum) in the stream where the solids can accumulate in the substrate potentially impacting benthic habitat. Trace metals (e.g., copper and zinc) in the CMD may be co-precipitated with iron and aluminum or remain in solution where they may remain potentially toxic to fish and benthic macroinvertebrates. The short distance from the discharge location to the Big South Fork suggests the metal precipitation would likely occur within the river potentially impacting water quality, benthic habitat, and aesthetics within

the river. Based on the above limitations, instream active treatment is not recommended as a remediation method for the Laurel Branch Creek CMD discharge.

Instream passive treatment employs a periodic limestone sand application to one or several locations within an impacted watershed. The limestone sand is applied directly into stream channels where the stream water contacts the limestone slowly dissolving it or carrying and distributing the sand throughout the stream length where it becomes incorporated in the stream bed. The limestone sand will slowly dissolve over time providing alkalinity to increase pH and neutralize acidity. The changes in pH result in the in precipitation of pH solubility dependent metals such as iron (ferric) and aluminum. This is a relatively new remediation technique that has gained interest in a number of states for treatment of CMD and acid deposition impacted waters. No long term studies have been conducted to determine frequency of sand application, number of locations, impacts on benthic communities, and effects of flood events on sustaining water quality conditions. In addition, this is an instream treatment which may have similar problems related to metal removal that was discussed above for instream active treatment.

Passive treatment has been found to provide successful treatment of CMD characteristic of the degraded water quality found in the Laurel Branch at low flows. However, passive treatment has not been employed to treat co-mingled CMD in a stream with flow variability that is likely to occur in the Laurel Branch. High flows associated with storm events could result in hydraulic overloading, accumulation of eroded sediments in the system, wash-out of substrates, and/or damage to the passive treatments system. Separation of the diffuse CMD discharges emanating from the spoil from un-contaminated stream flow may be possible. The CMD could then be conveyed to a location away from the stream channel and treated with an alkalinity generating vertical flow wetland treatment system.

Removal of the mine spoil is a remediation method which would remove the production of CMD by eliminating the source area. The mine spoil could be excavated from the site, hauled off-site and disposed of at a facility (e.g., lined landfill) where the spoil can be isolated and where any CMD produced can be treated. This remediation technique is a viable alternative but will require additional investigation to determine quantities and conditions of the mine spoil which can affect the costs of this proposed remediation technique. For example, the highly acidic nature and trace metal composition of the mine spoil may require disposal at a hazardous waste facility which can have tipping fees in excess of $100.00 per ton.

The remaining remediation technique identified is a lined stream channel to convey the stream on top of the spoil, preventing infiltration of stream water into the mine spoil. This remediation technique employs construction of a stream channel that contains an impervious synthetic (e.g., LLDPE) or geo-synthetic (GSL) liner and limestone rock. The impervious liner will prohibit stream water from infiltrating into the mine spoil where it can contact acid-bearing minerals producing the CMD. Preventing infiltration should minimize the CMD produced from site; some CMD may be produced from precipitation falling directly onto the mine spoil.

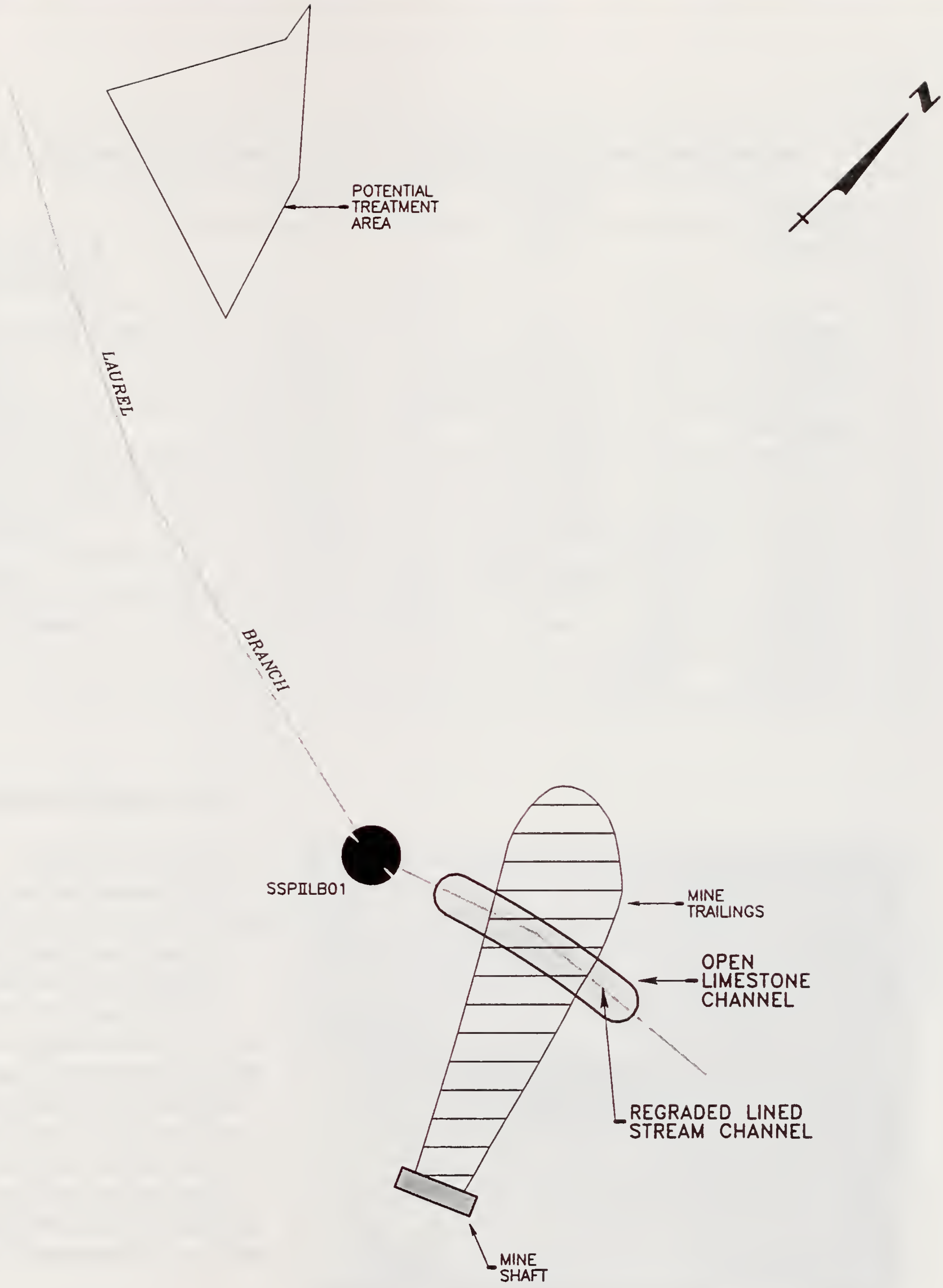
2. Conceptual Design

Based on the above evaluation, three alternatives are suitable to address the Laurel Branch site CMD discharge in the BISO. The three are: passive treatment employing vertical flow wetland design; removal of the mine spoil from the Laurel Branch Creek channel and adjacent slopes; and construction of a lined channel on top of the mine spoil. The three identified remedial actions will be evaluated for cost and treatment effectiveness (with respect to the water quality objectives) in the Phase III report. For this preliminary report, only the constructed lined channel will be considered for conceptual design.

The conceptual design for the constructed lined channel is depicted in Figure 7. As indicated in this plan view the channel would be located across the existing mine spoil only which is approximately 100 feet in length. This construction will likely require removal of a small amount of mine spoil to grade a channel with a stable slope (i.e., no waterfall). The recommended liner is a linear low density polyethylene (LLDPE) material with a thickness of 40 mm with a geotextile fabric placed on top. An LLDPE liner is preferred over a geosynthetic liner (GSL), a clay impregnated geotextile fabric, because of potential reactivity of acid materials with the clay in the GSL. The liner will be anchored into the subgrade on each side of the channel as well as the upstream and downstream ends. Limestone will be placed in the channel to provide roughness and stability. This limestone will also provide alkalinity to the contact water which will aid in neutralizing any acid inputs from the mine spoil (i.e., surface runoff and/or seepage).

3. Construction Costs

Construction costs for this remediation will include: mobilization and demobilization; diversion of water during construction; clearing and grubbing; grading of stream channel; disposal of excess mine spoil (if off-site); materials including LLDPE liner, geotextile fabric and limestone; installation of the LLDPE liner, geotextile and limestone, seeding, and erosion and sedimentation control measures. Table 2 summarizes the anticipated costs for the Laurel Branch project which are based engineering estimates from several recent projects. No cost estimates are provided for removal and disposal of mine spoil since it is assumed disposal will be on-site. Off-site disposal could considerably increase the cost of the project if the mine spoil is determined to be hazardous; tipping fees for hazardous material are approximately $100.00 per ton.



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RESTORATION STUDY

LAUREL BRANCH SITE

CONCEPTUAL REMEDIATION DESIGN

SCALE
1'=100'

FIGURE

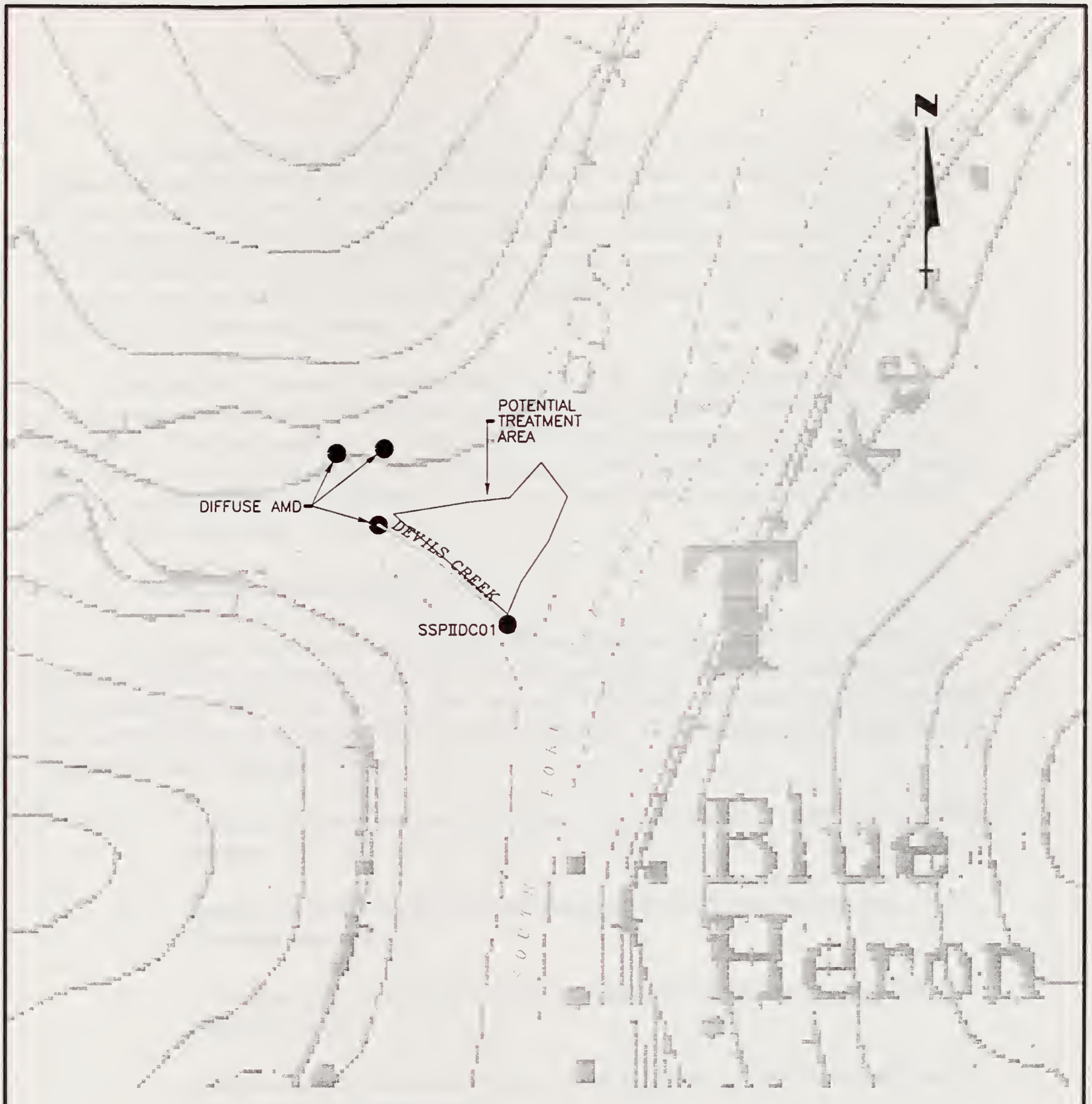
Table 2. Estimates of construction costs for the Laurel Branch lined stream channel.

Item	Quantity	Unit Cost	Total Cost
Mobilization & Demobilization	Job	Job	$5.000.00
Diversion of Water	Job	Job	$5,000.00
Grading	200 yd^3	$20.00 yd^3	$4,000.00
LLDPE Liner	150 yd^2	$30.00/yd^2	$4,500.00
Geotextile Fabric	150 yd^2	$5.00/yd^2	$750.00
Limestone	140 ton	$25.00/ton	$3,500.00
Seeding	½ acre	$1000.00/acre	$500.00
E&S Control	Job	Job	$2,000.00
		Total	$25.250.00

B. DEVILS CREEK SITE

The Devils Creek site is located on the western side of the Big South Fork in the vicinity of Blue Heron (see Figure 5). The diffuse CMD discharges enter Devils Creek a short distance, approximately 300 feet, upstream of the confluence with the Big South Fork (see Figure 8). The Devils Creek multi-point discharges associated with mine spoil and historic deep mining openings are located on the side slope of the watershed (see Plate 2).

Plate 2. CMD discharges located on the side slope above Devils Creek.



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DEVILS CREEK SITE
SITE CHARACTERISTICS

SCALE
1'=300'

FIGURE

Water quality data at the mouth of the Devils Creek from the Phase I and II monitoring program indicate pH varies from 3.1 to 6.9 and appears to be related to stream flow with low pHs occurring during low flows similar to observed in the Laurel Branch creek. Acidity, aluminum, iron, manganese and zinc are also related to discharge flow with higher concentrations at lower flows. The higher pH water quality at higher flows and the presence of macroinvertebrates immediately upstream of the CMD inflow point suggests the primary source of CMD to Devils Creek are these multi-point discharge.

Examination of the multi-point discharge area indicates the CMD emanates from primarily two discreet locations well up slope of the Devils Creek stream channel (see Figure 8). The source of the CMD appears to be from several drift mine openings and mine spoil on the side slope. A water quality sample from the discharge collected during the Phase I investigation indicates the multi-point discharge has a low pH (less than 2.7) and is moderately acidic with a reported value of 360 mg/L as $CaCO_3$.

1. Remediation Recommendations

The possible remediation methods available for resolving the water quality impacts on the Big South Fork associated with the Devils Creek discharge are limited to treatment BMPs. Site remediation BMPs would likely involve removal of spoil and mine seals which would likely have limited success in reducing CMD flow and/or strength. The treatment BMPs identified for the Devils Creek discharge include:

- Instream treatment of Devils Creek using active treatment systems (e.g., chemical dosers);
- Instream treatment of Devils Creek using passive treatment systems (e.g., limestone sand dosing);
- Treatment of the multi-point discharges using active treatment systems (e.g., chemical doser);
- Treatment of the multi-point discharges using passive wetland treatment systems (e.g., vertical flow wetlands);

Operation and maintenance limitations of instream active treatment discussed for the Laurel Branch Creek site also apply to Devils Creek. The Devils Creek flow is also inadequate to support use of a rotary-drum system which requires a minimum of 0.1 cfs to operate on a continuous basis (Zurbuch *et al.* 1996). Instream active treatment will result in precipitation of metals (primarily iron and aluminum) in the stream where the solids can accumulate in the substrate and potentially impact benthic habitat. Trace metals (e.g., copper and zinc) in the CMD may be co-precipitated with iron and aluminum or remain in solution where they may remain

potentially toxic to fish and benthic macroinvertebrates. The short distance from the discharge location to the BISO suggests the metal precipitation would likely occur within the BISO potentially impacting water quality, benthic habitat, and aesthetics within the river. Based on the above limitations, instream active treatment are not recommended as a remediation methods for the Devils Creek.

Active treatment of the multi-point discharge is a viable alternative if a settling basin is provided in the active treatment design. Active treatment with settling will remove iron and aluminum as well as trace metals from the Devils Creek CMD discharge. However, operation and maintenance limitations, similar to discussed for instream active treatment, but also including periodic dredging of settling pond, would prohibit the use of active treatment of the discharge at a remote location such as the Devils Creek location.

Instream passive treatment employing a periodic limestone sand application to a location downstream of the discharge to Devils Creek would be affected by the short distance to the BISO. This short distance could result in significant accumulation of metals in the BISO. In addition, the short distance to the BISO may be insufficient for the limestone sand to completely react with the acidity in Devils Creek resulting in water quality impacts to areas of the BISO. Limited access to the Devils Creek site may also create problems in replenishing the limestone sand on a periodic basis.

Passive wetland treatment has been found to provide successful treatment of CMD characteristic of the degraded water quality found in the Devils Creek CMD multi-point discharges. However, passive treatment is not recommended to treat co-mingled CMD discharge flow and Devils Creek flow because of the stream flow variability that has been observed for Devils Creek could jeopardize the treatment effectiveness of a passive wetland treatment system. Treatment of the multi-point CMD discharge can be accomplished by collecting the discreet points and conveying them to a common location; such as the identified potential treatment area (see Figure 8).

Treatment of the Devils Creek CMD discharges will require a passive treatment system capable of generating alkalinity. Alkalinity generating treatment technologies identified in Section I.B. include ALD, surface flow anaerobic wetland and anaerobic vertical flow wetland designs. In addition to alkalinity generation, the passive treatment system must be capable of lowering the trace metal concentrations; chromium, copper and zinc were found at concentrations greater than the detection limits in Devils Creek and the CMD discharge. The limitations of each technology was presented in Table ??. The elevated aluminum (2.8 mg/L) and high ferric iron (61.6 mg/L) measured in the discharge indicates the ALD technology would be inappropriate. The anaerobic surface flow wetland design would be capable of providing alkalinity but the required treatment area for this design would likely exceed available area. The remaining technology, anaerobic vertical flow wetland, is capable of treating the acidity levels found in the Devils Creek discharge and providing excess alkalinity. In addition, the anaerobic conditions provided in this design have been found to lower trace metal concentrations. Therefore, the

anaerobic vertical flow wetland design is recommended as the technology of choice to treat the Devils Creek CMD discharge.

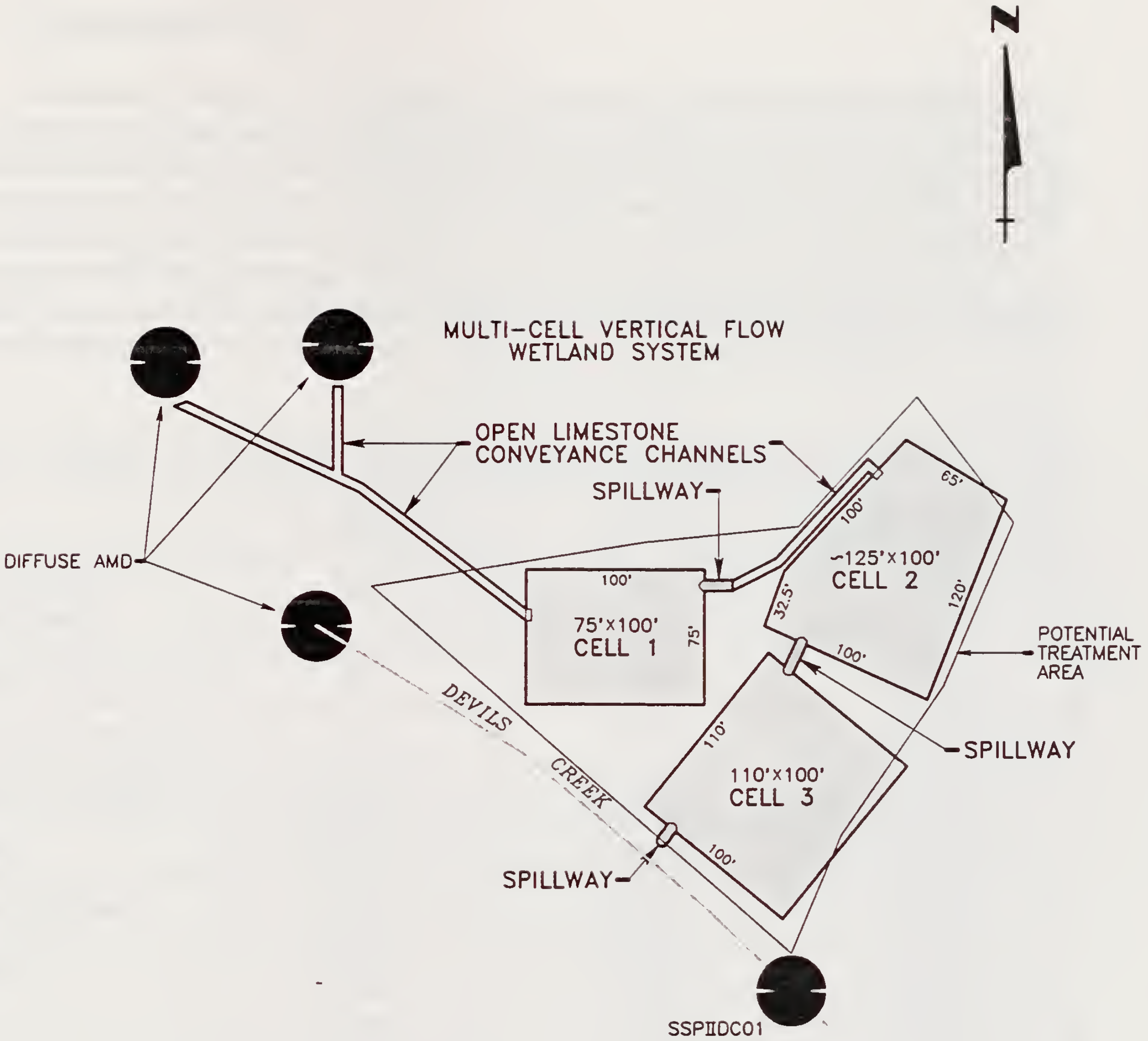
2. Conceptual Design

Based on the above evaluation, only passive wetland treatment is suitable to address the Devils Creek CMD discharge to the Big South Fork. Of the passive wetland treatment technologies available, anaerobic vertical flow wetland design is most appropriate to treat the Devils Creek CMD discharge.

The conceptual design for the anaerobic vertical flow wetland is depicted in Figure 9. As indicated in this plan view a collection channel will convey the multi-point CMD discharge across the slope to the anaerobic vertical flow wetland located at the potential treatment area, a distance of approximately 200 feet. The conveyance channel will be a geotextile-lined channel containing limestone material.

The Devils Creek CMD discharge was sampled only during the BISO characterization study (Phase I Report). Additional sampling will be necessary to characterize the discharge prior to final design. In the absence of this data, the CMD discharge flow rate of 45 gpm used to develop the conceptual design was estimated based on data collected from Devils Creek, the CMD discharge chemistry and employing a mass balance equation. Applying this flow rate to the CMD water chemistry data for the discharge results in an acid loading of 88,300 GPD which was used to determine the treatment area required for the vertical flow wetland treatment system. Acid loading was used because acid removal is the only parameter for which design information for vertical flow wetlands is available. An acidity removal rate of 25 GDM was used to determine total treatment area size. A design model developed by Gannett Fleming was used to determine optimal number of cells and treatment area in each cell within the vertical flow system. The model considers acid loading, hydraulic detention time and effluent quality from the vertical flow wetland treatment cell (assumed alkalinity of 100 mg/L from the underdrain of vertical flow wetland treatment systems).

A single cell, vertical flow wetland treatment system would require 33,000 ft^2 of treatment area to achieve adequately treat (i.e., acidity = 0 mg/L and alkalinity > 0 mg/L) CMD discharge on Devils Creek. A multi-cell vertical flow wetland that would achieve this same effluent alkalinity would consist of three cells of varying size; Cell 1 containing 7500 ft^2, Cell 2 containing 10,470 ft^2, and Cell 3 containing 11,000 ft^2. The total treatment area of the multi-cell system is 28,970 ft^2 a greater than 10 percent reduction in treatment area which will likely reflect a decrease in project cost. In addition, the long term operation and treatment effectiveness is likely to be improved in a multi-cell system containing redundant components.



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RESTORATION STUDY

DEVILS CREEK SITE

CONCEPTUAL REMEDIATION DESIGN

SCALE
1'=100'

FIGURE

3. Construction Costs

Construction costs for this remediation will include: mobilization and demobilization; care of water during construction; clearing and grubbing; grading associated with channel and treatment cell construction; piping (e.g., underdrain system); limestone and an organic substrate (e.g., spent mushroom compost); miscellaneous materials; seeding of exposed soils; and erosion and sedimentation control measures. Table 3 summarizes the anticipated costs for the Devils Creek project which are based engineering estimates from several recent projects. No cost estimates are provided for required fill for construction of the treatment system and/or disposal of excess material since these quantities are unknown, determined during final design.

Table 3. Estimates of construction costs for the Devils Creek passive treatment system.

Item	Quantity	Unit Cost	Total Cost
Mobilization & Demobilization	Job	Job	\$15,000.00
Care of Water	Job	Job	\$5,000.00
Clearing & Grubbing	Job	Job	\$5,000.00
Channel Excavation	200 yd^3	\$5.00/yd^3	\$1,000.00
Grading	3000 yd^3	\$10.00/yd^3	\$30,000.00
Geotextile Fabric	170 yd^2	\$6.00/yd^2	\$1,000.00
Limestone	2000 ton	\$30.00/ton	\$60,000.00
Geonet	3400 yd^2	\$1.50/yd^2	\$5,100.00
Organic Substrate	2200 yd^3	\$30.00/yd^3	\$66,000.00
Piping	Job	Job	\$35,000.00
Misc. Rock Material	200 ton	\$25.00/ton	\$5,000.00
Seeding	1½ acre	\$1000.00/acre	\$1,500.00
E&S Control	Job	Job	\$5,000.00
		Total	\$234,600.00

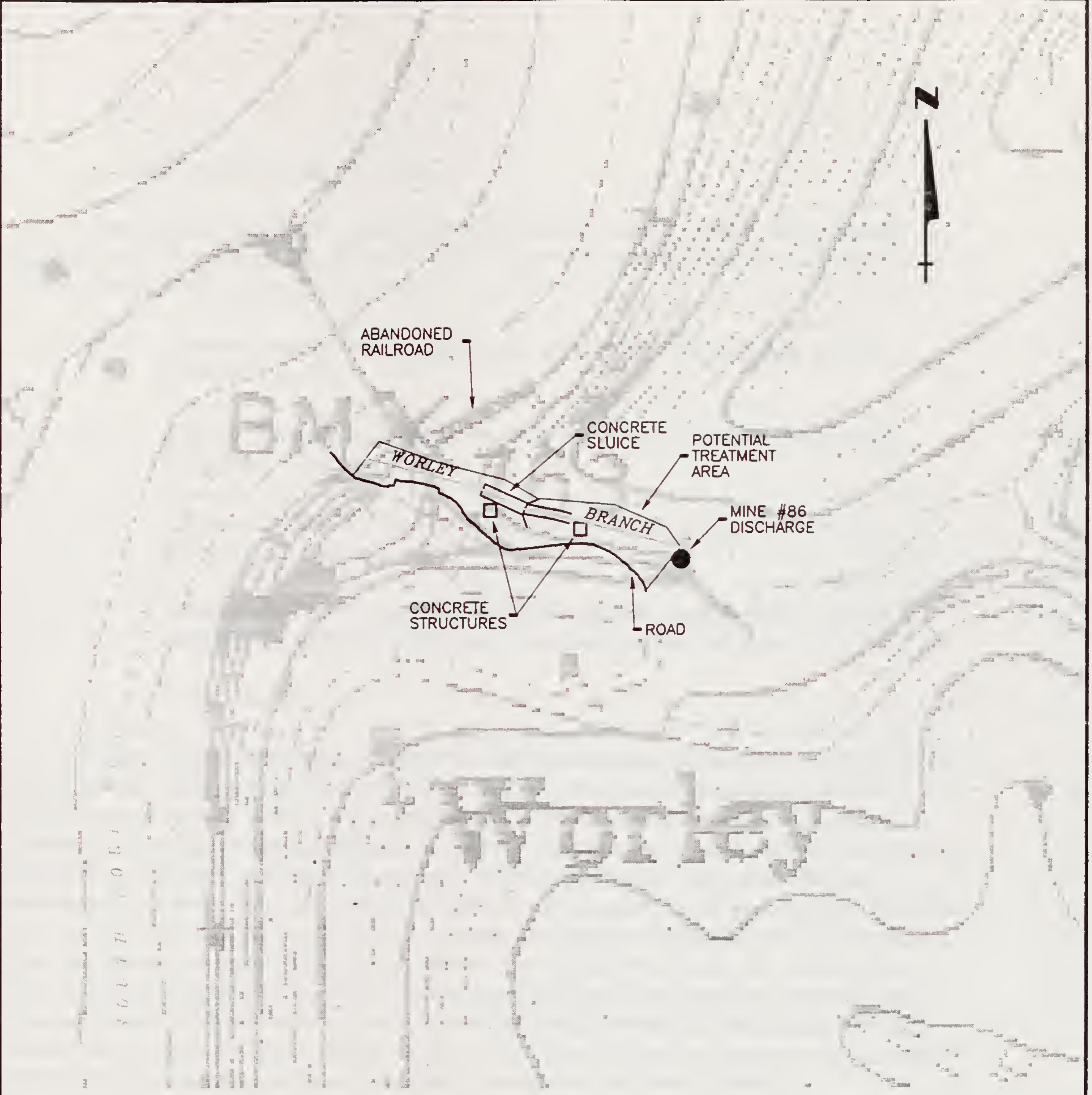
C. WORLEY MINE #86 SITE

Plate 3. Mine #86 discharge to Worley Branch Creek.

The Worley Mine #86 Site is located on the eastern side of the Big South Fork at the northern (downstream) boundary of the BISO study area (see Figure 5). The Mine #86 CMD discharge enters Worley Branch a short distance, approximately 600 feet, upstream of the confluence with the Big South Fork (see Figure 10). The Mine #86 CMD discharge is associated with a collapsed deep mine entry from historic mining that is located near the stream elevation on the southern side slope of the Worley Branch (see Plate 3).

Water quality samples collected from the Mine #86 discharge during the Phase I investigation indicates the discharge has a high pH (greater than 5.5) and is moderately acidic with a reported values ranging from 100 to 250 mg/L as $CaCO_3$. Iron is elevated with concentrations exceeding 100 mg/L and is almost entirely in the form of ferrous iron. Aluminum concentrations in the discharge are very low (less than 1 mg/L) which is likely due to the elevated pH of the discharge; aluminum has a pH dependent solubility.

Water quality data at the mouth of the Worley Branch from the Phase I and II monitoring program indicate pH is relatively constant ranging from 5.5 to 6.5 and unlike the other streams (i.e., Laurel Branch and Devils Creek) does not appear to be related to stream flow. Acidity, iron, manganese and zinc show a slight relationship with flow with higher concentrations occurring at lower stream flows. Aluminum is well below 1 mg/L which is the result of the higher pH of the stream and the CMD discharge. The presence of macroinvertebrates immediately upstream of the Mine #86 CMD inflow point suggests the primary source of CMD to Worley Branch is the Mine #86 discharge. The high pH in Worley Branch, the presence of moderate acidity, and iron as primarily ferrous iron indicates the distance (travel time) to the Big South Fork is too short to adequately oxidize the ferrous iron and precipitate iron oxide which would cause a corresponding decrease in pH.



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WORLEY MINE #86 SITE

SITE CHARACTERISTICS

SCALE
1'=300'

FIGURE

1. Remediation Recommendations

The possible remediation methods available for resolving the water quality impacts on the Big South Fork associated with the Worley Branch discharge include both site remediation and treatment BMPs. The BMPs include:

- Instream treatment of Worley Branch using active treatment systems (e.g., chemical dosers);
- Instream treatment of Worley Branch using passive treatment systems (e.g., limestone sand dosing);
- Treatment of the Worley Mine #86 CMD discharge using active treatment systems (e.g., chemical doser);
- Treatment of the Worley Mine #86 CMD discharge using passive wetland treatment systems (e.g., ALD and/or vertical flow wetlands); and
- A wet mine seal.

Operation and maintenance limitations of instream active treatment discussed for the Laurel Branch Creek site also apply to Worley Branch. The Worley Branch flow is also inadequate to support use of a rotary-drum system which requires a minimum of 0.1 cfs to operate on a continuous basis (Zurbuch *et al.* 1996). Instream active treatment will also result in precipitation of metals (primarily iron and aluminum) in the stream where the solids can accumulate in the substrate and potentially impact benthic habitat. Trace metals (e.g., copper and zinc) in the CMD may be co-precipitated with iron and aluminum or remain in solution where they may remain potentially toxic to fish and benthic macroinvertebrates. The short distance from the Worley Mine #86 discharge location to the Big South Fork suggests that the metal precipitation would likely occur within the river, potentially impacting water quality, benthic habitat, and aesthetics within the river. Based on the above limitations, instream active treatment methods are not recommended as a remediation method for the Worley Branch.

Active treatment of the Worley Mine #86 discharge is a viable alternative if a settling basin is provided in the active treatment design. Active treatment with settling will remove iron and aluminum, as well as trace metals from the Worley Branch CMD discharge. However, operation and maintenance limitations, similar to discussed for instream active treatment, and also including periodic dredging of settling pond, may prohibit the use of active treatment at limited access location such as the Worley Branch location.

Instream passive treatment employing a periodic limestone sand application to a location downstream of the discharge to Worley Branch would be affected by the short distance to the Big South Fork, which could result in significant accumulation of metals in the river. The high pH and high ferrous iron concentration at the Worley Branch sampling location provides evidence regarding the limited oxidation and precipitation that would likely occur with alkaline addition. In addition, the short distance to the Big South Fork may be insufficient for the limestone sand to completely react with the acidity in Worley Branch resulting in water quality impacts to areas within the river. Limited access to the Worley Mine #86 Site may also create problems in replenishing the limestone sand on a periodic basis.

Passive wetland treatment has been found to provide successful treatment of CMD characteristic of the degraded water quality found in the Worley Branch CMD discharge. Passive treatment is not recommended to treat co-mingled CMD discharge flow and Worley Branch flow because of the stream flow variability that has been observed for Worley Branch could jeopardize the treatment effectiveness of a passive wetland treatment system. However, the site characteristics (i.e., narrow, steeply sloped channel) limit the available area for treatment if areas in the vicinity of the stream channel are excluded. Therefore, treatment of the Worley Mine #86 CMD discharge will be accomplished within the existing stream channel and by providing bypass of the stream flow (except extreme storm events) around the treatment system.

Treatment of the Worley Branch CMD discharge will require a passive treatment system capable of generating alkalinity as well as oxidizing and precipitating high iron concentrations. Alkalinity generating treatment technologies identified in Section ?? include ALD, surface flow anaerobic wetland and anaerobic vertical flow wetland designs. The low aluminum (less than 1 mg/L) and high ferrous iron ratio (approaches 100%) measured in the Mine #86 discharge indicates the ALD technology would be appropriate. However, acidity levels reported for the Mine #86 discharge occasionally approach and/or exceed the alkalinity generating potential of an ALD. This indicates the ALD will have to be used in conjunction with some other alkalinity generating system (e.g., anaerobic surface flow and vertical flow wetlands).

The anaerobic surface flow wetland design would be capable of providing alkalinity but the required treatment area for this design would likely exceed available area. The anaerobic vertical flow wetland is capable of treating the acidity levels found in the Worley Branch Mine #86 discharge, but may be affected by the high iron concentrations which exceed 100 mg/L; therefore use of vertical flow treatment will require pre-treatment to lower iron concentrations. The anaerobic conditions provided in the vertical flow design will also be required to lower trace metal concentrations; zinc was found at concentrations greater than the detection limits in Worley Branch discharge. Therefore, the anaerobic vertical flow wetland design is recommended as a the alkalinity generating technology to be used in conjunction with an ALD to treat the Worley Branch CMD discharge.

Pre-treatment to remove iron prior to the anaerobic vertical flow passive treatment system can be accomplished in an aerobic surface flow wetland as long as sufficient oxygen and

alkalinity is present to oxidize and precipitate the ferrous iron. Therefore, an aerobic surface flow wetland is also recommended for the passive treatment system as a pre-treatment system before the anaerobic vertical flow wetland.

In addition to the multi-system passive treatment, a wet mine seal is recommended for the Mine #86 discharge because of the presence of ferric iron (occasionally reported for the discharge) which could reduce the effectiveness of the ALD. A wet seal would allow passage of water from the mine pool while preventing oxygen from entering the mine complex where it can oxidize ferrous iron to ferric iron. The mine seal could also aid in stabilizing discharge flows which appear to vary, possibly from clogging of the discharge point in the mine opening with iron oxides.

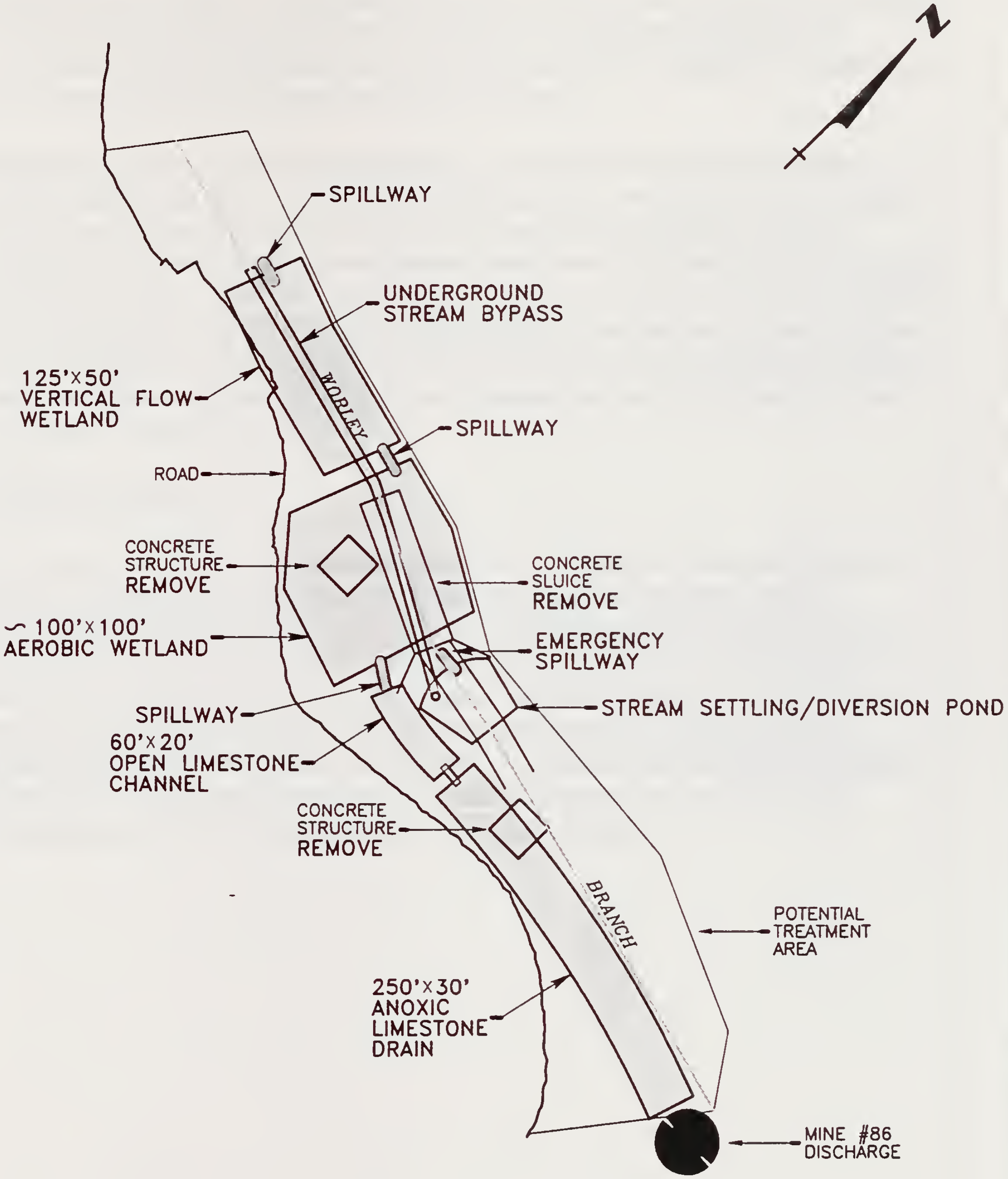
2. Conceptual Design

Based on the above evaluation, a mine seal and passive wetland treatment system appear suitable to address the Worley Branch CMD discharge to the Big South Fork. As indicated above, the complex nature of the discharge will require use of several types of passive wetland treatment technologies, i.e., ALD, aerobic wetland and anaerobic vertical flow wetland. The passive treatment system for the Mine #86 discharge is depicted in Figure 11.

The Worley Branch CMD discharge was sampled during the BISO characterization study (Phase I Report) and the Phase II monitoring. Based on this data, the Mine #86 discharge flow rate averaged 50 gpm and ranged from 10 to 180 gpm. The acidity of the discharge averaged 165 mg/L with a range of 0 to 240 mg/L. Applying the Mine #86 average and maximum flow rate and assumptions and design guidance in Hedin *et al.* 1994 an ALD size was estimated 45,000 ft^2, which was configured as depicted in Figure 11. This ALD would be expected to provide a minimum alkalinity of 150 mg/L over its greater than 25 year life expectancy.

An open limestone channel is located after the ALD to provide aeration of the discharge prior to the aerobic wetland. The aerobic wetland was located following the open limestone channel. The aerobic wetland, containing approximately 10,000 ft^2, was sized based on an average flow, an influent concentration of 100 mg/L, an effluent iron concentration of 30 mg/L (limitation of the vertical flow wetland), and an iron removal rate of 20 GDM (Hedin *et al.* 1994) which is for alkaline waters. The recommended aerobic wetland will be an open water system with approximately 6 feet of depth for long term storage of iron oxide precipitates.

The anaerobic vertical flow wetland is located after the aerobic wetland and will function for additional alkalinity generation and removal of trace metals (e.g., zinc) remaining in the water after the aerobic wetland. The vertical flow wetland was sized based on an average acidity load 14,000 GPD remaining after the ALD, based on an acidity concentration of approximately 50 mg/L and a flow of 50 gpm, and the acidity removal rate of 25 GDM (Dietz and Stidinger 1996). The vertical flow wetland size also has a flow capacity of 100 gpm for its underdrain system, based on a permeability of 0.001 cm/sec for the organic layer, which reflects the volume of water


N
SPILLWAY
UNDERGROUND STREAM BYPASS
WORLEY
125'x50' VERTICAL FLOW WETLAND
SPILLWAY
ROAD
CONCRETE STRUCTURE REMOVE
CONCRETE SLUICE REMOVE
~ 100'x100' AEROBIC WETLAND
EMERGENCY SPILLWAY
STREAM SETTLING/DIVERSION POND
SPILLWAY
60'x20' OPEN LIMESTONE CHANNEL
CONCRETE STRUCTURE REMOVE
BRANCH
POTENTIAL TREATMENT AREA
250'x30' ANOXIC LIMESTONE DRAIN
MINE #86 DISCHARGE

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WORLEY MINE #86 SITE
CONCEPTUAL REMEDIATION DESIGN

SCALE
1'=100'

FIGURE

that can be treated for trace metals. The effluent from the underdrain should contain an alkalinity of at least 100 mg/L which should be adequate to neutralize any acidity remaining in the discharge. The optimal depth of the limestone layer in the vertical flow wetland was determined to be three feet, based on a hydraulic detention time of 16 hours.

The final component of the conceptual design is a stream flow bypass system which consists of a settling/diversion pond, an emergency spillway and an underground stream bypass pipe. This unit will collect stream flow and convey it underneath the treatment system to prohibit co-mingling of the stream and discharge which could result in hydraulic overlaoding and failure of the passive treatment units (i.e., aerobic and anaerobic vertical flow wetlands) located down gradient of the stream flow. The pond and bypass pipe will be designed to convey stream flows up to a certain storm flow (e.g., 10 or 25 year flow events). Flows exceeding this amount will be conveyed over the emergency spillway of the diversion pond and the spillways of the aerobic and anaerobic vertical flow wetlands.

3. Construction Costs

Construction costs for this remediation will include: mobilization and demobilization; care of water during construction; mine seal installation, clearing and grubbing; grading associated with treatment cell construction; piping (e.g., underdrain system); limestone and an organic substrate (e.g., spent mushroom compost); miscellaneous materials; installation of stream bypass pipe; seeding of exposed soils; and erosion and sedimentation control measures. Table 4 summarizes the anticipated costs for the Worley Branch project which are based engineering estimates from several recent projects. No cost estimates are provided for required fill for construction of the treatment system and/or disposal of excess material since these quantities are unknown, and would be determined during final design.

Table 4. Estimates of construction costs for the Worley Branch passive treatment system.

Item	Quantity	Unit Cost	Total Cost
Mobilization & Demobilization	Job	Job	$15,000.00
Care of Water	Job	Job	$15,000.00
Mine Seal Intall.	Job	Job	$25,000.00
Clearing & Grubbing	Job	Job	$5,000.00
Grading	6,000 yd^3	$10.00/$yd^3$	$60,000.00
Geotextile Fabric	1,000 yd^2	$3.00/$yd^2$	$3,000.00
LLDPE Liner	900 yd^2	$10.00/$yd^2$	$9,000.00
Limestone	2,200 ton	$30.00/ton	$66,000.00
Geonet	700 yd^2	$1.50/$yd^2$	$1,050.00
Organic Substrate	700 yd^3	$30.00/$yd^3$	$21,000.00
Piping	Job	Job	$15,000.00
Stream Bypass Pipe	Job	Job	$30,000.00
Misc. Rock Material	250 ton	$25.00/ton	$6,250.00
Seeding	1½ acre	$1000.00/acre	$1,500.00
E&S Control	Job	Job	$5,000.00
		Total	$277,800.00

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ATTACHMENTS

Example Final Design Project

Example Project # 2
Schrader Creek AML Treatment Project
Bradford County, PA
Pennsylvania Department of Environmental Protection
Bureau of Abandoned Mine Reclamation

Project Description:

Gannett Fleming is currently under contract by the Pennsylvania Department of Protection resources to provide passive treatment designs for two AMD discharges on abandoned mined lands that impact a high quality trout stream, Schrader Creek, located in Bradford County, Pennsylvania. The two discharges, Falls Creek and Long Valley Run, degrade water quality in Schrader Creek for a distance of about 15 stream miles.

The passive treatment systems designed by Gannett Fleming employ an innovative design known as subsurface flow wetlands which have the capacity to remove high levels of acidity and discharge excess alkalinity. As a result, Gannett Fleming's designs are intended to not only treat the two AMD discharges, but provide alkalinity to mitigate the impacts of un-treated AMD located elsewhere in the watershed. In addition to the above water quality improvement feature of the systems, the Falls Creek passive treatment system is one of the largest systems of this type of design undertaken and it provides unique flow controls to treat AMD discharge in excess of 2 million gallons per day.

Excerpts of project information follow to demonstrate Gannett Fleming's project knowledge and involvement:

☐ schedule of price estimates
☐ selected technical specifications
☐ selected contract drawings

SCHEDULE OF PRICE ESTIMATES
SCHRADER CREEK PROJECT
AMD 08(3295)101.1

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	TOTAL
1.	Mobilization and Demobilization	Job	Job	L.S.	$29,000.00
2.	Clearing and Grubbing				
	Site 1	Job	Job	L.S.	$5,950.00
	Site 2	Job	Job	L.S.	$2,000.00
3.	Diversion and Care of Water				
	Site 1	Job	Job	L.S.	$2,500.00
	Site 2	Job	Job	L.S.	$400.00
4.	Grading				
	Site 1	19.501	yd^3	$8.54	$166,538.54
	Site 2	905	yd^3	$8.54	$7,728.70
5.	Channel Excavation	1,825	yd^3	$4.50	$8,212.50
6.	Impervious Lining & Geotextile Fabric				
	a) Smooth LLDPE				
	Site 1	8.914	yd^2	$3.15	$28,079.10
	Site 2	1,568	yd^2	$3.15	$4,939.20
	b) Textured LLDPE				
	Site 1	4,941	yd^2	$4.33	$21,394.53
	Site 2	1,371	yd^2	$4.33	$5,936.43
	c) Geotextile Fabric				
	Site 1	13,855	yd^2	$1.35	$18,704.25
	Site 2	2,939	yd^2	$1.35	$3,967.65
7.	Maintenance Road				
	a) 2RC Ganualar Material	2,500	yd^2	$1.58	$3,950.00
	b) !8-inch Diameter HDPE Culverts	60	L.F.	$20.00	$1,200.00
8.	Rock Lining				
	a) R-3 Rock				
	Site 1	1,399	yd^2	$8.00	$11,192.00
	Site 2	444	yd^2	$8.00	$3,552.00
	b) R-3 Rock with Geotextile				
	Site 1	864	yd^2	$10.00	$8,640.00
	Site 2	122	yd^2	$10.00	$1,220.00
	c) R-4 Rock with Geotextile				
	Site 1	108	yd^2	$15.00	$1,620.00
	Site 2	474	yd^2	$15.00	$7,110.00
9.	Wetland Treatment Unit Material				

SCHEDULE OF PRICE ESTIMATES
SCHRADER CREEK PROJECT
AMD 08(3295)101.1

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	TOTAL
	a) AASHTO No. 57 Limestone				
	Site 1	7,663	ton	$32.00	$245,216.00
	Site 2	1,442	ton	$32.00	$46,144.00
	b) Spent Mushroom Compost				
	Site 1	6,366	yd^2	$20.00	$127,320.00
	Site 2	1,207	yd^2	$20.00	$24,140.00
10.	Geonet				
	Site 1	10,260	yd^2	$3.30	$33,858.00
	Site 2	1,964	yd^2	$3.30	$6,481.20
11.	Piping				
	a) Leachate Collection System and 8-inch Bypass Pipe				
	Site 1	Job	Job	L.S.	$75,525.00
	Site 2	Job	Job	L.S.	$17,390.00
	b) 12-inch Bypass Pipe System				
	Site 1	Job	Job	L.S.	$19,500.00
	Site 2	Job	Job	L.S.	$7,000.00
12.	Seeding				
	a) Seed Bed Preparation	5.4	acre	$3,615.00	$19,521.00
	b) Agricultural Limestone	10.8	ton	$55.00	$594.00
	c) Commercial Fertilizer	2160	lbs.	$2.00	$4,320.00
	d) Seed - Type 1	350	lbs.	$10.00	$3,500.00
	e) Seed - Type 1	200	lbs.	$16.50	$3,300.00
	f) Mulching	5.4	acre	$1,000.00	$5,400.00
13.	Wetland Planting				
	Site 1	2.30	acre	$2,510.00	$5,773.00
	Site 2	0.46	acre	$2,510.00	$1,154.60
14.	Implementation of the E&SC Plan				
	Site 1	Job	Job	L.S.	$2,250.00
	Site 2	Job	Job	L.S.	$2,000.00
15.	Office Facilities	Job	Job	L.S.	$2,500.00
	TOTAL AMOUNT OF ESTIMATE				$996,721.70

TECHNICAL SPECIFICATIONS

SCOPE OF PROJECT

The intent of this project is to remediate acid mine drainage from two abandoned deep mine sources that result in degradation of water quality in Schrader Creek, in accordance with the Drawings and these specifications.

The work involved essentially consists of: mobilization and demobilization, clearing and grubbing, diversion and care of water, channel excavation, grading, impervious liner and geotextile fabric installation, maintenance access road construction, culvert installation, placement of rock lining with filter material, placement of wetland treatment unit material, geonet installation, polyvinyl chloride piping installation, seeding, wetland planting, and erosion and sedimentation control.

The project is located north of Schrader Creek, in Franklin Township, Bradford County, and consists of two sites. Site 1 is located on the west side of T361, approximately 300 feet south of the intersection of T361 and T362. Site 2 is located within State Game Lands No. 36, approximately 3/4 mile east of Site 1 along a private access road extending from the eastern terminus of T362.

TECHNICAL SPECIFICATION NO. 1 - MOBILIZATION AND DEMOBILIZATION

1.1 SCOPE:

This item refers to the delivery and assembling of all plant and equipment at the site preparatory to initiating the work and for removing it therefrom when all work has been completed.

1.2 MEASUREMENT AND PAYMENT:

Payment will be made at the established contract lump sum prices bid for "Mobilization and Demobilization Site 1" and "Site 2" Forty percent (40%) of this bid item will be paid following completion of moving onto the site including complete assembly in working order of all equipment necessary to perform the required work and the satisfactory storage at the site of all such materials and supplies. Prior to the commencement of work, the Contractor's plan and equipment will be inspected and shall be subject to the Department's approval. The remaining sixty percent (60%) of this bid item will be paid when all equipment has been removed and satisfactory cleanup operations have been performed following the satisfactory completion of the contract.

TECHNICAL SPECIFICATION NO. 2 - CLEARING AND GRUBBING

2.1 SCOPE:

Work under this specification shall include the removal and disposal of all natural growth and debris within the designated grading area.

Limits for clearing and grubbing shall be marked in the field by the Contractor and approved by the Department before commencing the work.

2.2 PROCEDURE:

A. Clearing and Grubbing - Clearing and grubbing shall consist of the removal and disposal of all natural growth and debris encountered.

B. Disposal - All cleared and grubbed materials shall be disposed of in accordance with Subsection 4.10H of the General Conditions and as indicated herein. If burning is permitted, it shall be performed in compliance with the General Conditions and in a manner approved by the Department. At no time shall a fire be left unattended, and the Contractor will be held responsible for any damage resulting from such fires.

Brush and trees may be placed in brush barriers or piles along the perimeter of the Contractor's Working Area. If the Department finds the concentration or size of brush and/or trees in the brush piles or barriers to be objectionable or excessive, he may require the Contractor to remove such excessive amounts of brush and/or trees through burning and/or disposal at a permitted site.

Domestic trash and large objects (such as car or truck bodies, refrigerators, etc.) are to be disposed of off site at a permitted location. The Contractor should take reasonable care to prevent additional dumping during and after construction.

At no time shall any cleared and grubbed material be placed on land outside of the Limits of the Contractor's Working Area without written permission of the owner of the property involved, nor shall damage of any nature be inflicted upon adjoining properties by unwarranted entry on such land. The Contractor shall furnish the Department with copies of agreements with releases from the involved property owner prior to any disposal of materials off site.

2.3 MEASUREMENT:

Clearing and grubbing will be considered and measured as a job.

2.4 PAYMENT:

Payment for “Clearing and Grubbing” will be made at the contract lump sum prices bid for “Site 1” and for “Site 2”, which prices shall include full compensation for the work described.

TECHNICAL SPECIFICATION NO. 3 - DIVERSION AND CARE OF WATER

3.1 SCOPE:

The Contractor shall be required to keep all water, including existing mine water discharges, surface water, groundwater and seepages, out of excavated impoundments until after impoundments, spillways and ditch excavation and placement of the wetland base materials have been completed.

3.2 PROCEDURE:

The Contractor shall use pumps, diversion ditches or other suitable methods to provide diversion of the water. Any ditches constructed for the purposes of water diversion shall be backfilled, compacted and revegetated after water diversion has ceased. Any pipes used for purposes of water diversion shall be removed after water diversion has ceased. All diverted water shall be directed into existing drainageways. All work shall be in accordance with Sections 4.10I "Anti-Pollution Measures," and 4.10J "E&S Control Plan" of the General Conditions. After impoundments, spillways, piping, ditch excavation and placement of the wetland base materials have been completed and approved, the Contractor shall direct the mine water into the impoundments.

3.3 MEASUREMENT:

Diversion and care of water, when satisfactorily completed and approved by the Department, will be measured as a job.

3.4 PAYMENT:

Payment for "Diversion and Care of Water" will be made at the contract lump sum prices bid for "Site 1" and for "Site 2", which prices shall include full compensation for all labor, equipment and materials to perform the work described.

TECHNICAL SPECIFICATION NO. 4 - GRADING

4.1 SCOPE:

The work covered by this section consists of performing all excavations and fill to the approximate lines and grades shown on the Drawings, and all other related and incidental operations necessary to insure the runoff of surface water. The work will also include all operations necessary to remove and bury any acid-producing materials and maintenance of graded areas. Earthwork for construction of the maintenance road is included under this section. Earthwork for construction of the Channels A, B, C, D, and E is not included under this section.

4.2 MATERIALS:

A. Treatment Cell Embankment Material - All material furnished for use as Treatment Cell Embankment Material shall meet the following requirements:

1. Unified Soil Classification System classification of GM, GC, SW, SM, SC, SC-SM, CL or GC-GM. Different soil types may be used on different areas of the site. However, the Contractor shall not mix different soil types within a given area or section of the site or embankment.
2. Water content between 4 percentage points dry of optimum and 4 percentage points wet of optimum water content.
3. Maximum particle size will be 6 inches.
4. Maximum amount of particles over 3 inches in size not to exceed 20 percent of total volume of material.

4.3 PROCEDURE:

A. General - All excavation under this specification is unclassified and all material encountered, regardless of character or hardness, shall be removed to the lines and grades shown on the Drawings. Material from required excavation that is best suited for vegetative growth and approved by the Department, shall be used as surface material. Stockpiling of this material may be required.

Any acid-forming material encountered in the excavation shall be placed outside of drainage courses and above any water bearing area or strata in fill areas approved by the Department and covered with a minimum of four (4) feet of clean fill material. Any area having acid-forming material exposed at the proposed grade line shall be overexcavated a minimum of two (2) feet and such area backfilled with clean fill. Erosion gullies shall be backfilled to the adjacent ground elevation and compacted by making the maximum practical use of available hauling and spreading equipment.

When suitable topsoil is available on the site, the topsoil from excavation or embankment areas shall be stripped and stockpiled separately prior to commencement of grading operations. Stockpiles shall be placed as shown on the Drawings or as directed by the Department, and shall not be placed on areas which subsequently will require any excavation or embankment. If, in the judgement of the Department, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further rehandling. Stockpiled topsiol shall be spread as surface material during final grading.

All earth for fill shall be provided from the required excavation.

When the volume of the excavation exceeds that required to construct the embankments or to refill trenches and other excavations, the excess material is to

be hauled to and disposed of within the limits of areas shown on the Drawings or as directed by the Department. Grade excess material to allow positive drainage of the area and of adjacent areas. Do not place excess material within the limits of the existing drainageway north of the Long Valley Run (Site 2) treatment system. Grade excess material evenly within the limits of the disposal area at slopes of 20 percent or flatter.

All grading shall be controlled so that the graded areas will blend into the adjacent topography. The final grade surface shall be free from stones or debris which would be detrimental to seeding or soil supplement operations. Both the rough grade and final grade shall be approved by the Department before subsequent operations are performed.

If trucks are utilized, the loading and hauling of excavated material shall be done in a manner which shall insure that the material can not "spill" from the truck onto public roadways, street, or private property while the loaded truck is in transit. In the event that "spills" do occur, the Contractor shall be required to clean the affected areas and traffic shall be maintained at all times.

Traveled roads, including Township Road No. 362 and private access roadways to the Long Valley Run (Site 2) construction area, shall be the responsibility of the Contractor. The Contractor shall be responsible for any damage done to traveled roads by his equipment, including patching potholes and repairing the roadways. Access to and from the Long Valley Run construction area shall be coordinated with the property owner to relocate existing fencing and minimize property damage. All damage to the property resulting from construction shall be the responsibility of the Contractor.

B. Treatment Cell Embankments

1. Subgrade Preparation: Compact subgrade prior to embankment construction. Remove any soft, wet, or otherwise unsuitable material to the limits directed by the Department.
2. Placement:
   a. Place, spread, condition, and compact Treatment Cell Embankment Material using approved equipment and methods.
   b. Reduce clods down to a maximum size of 3 inches before placement.
   c. Compact the Treatment Cell Embankment Material in lifts no thicker than 12 inches compacted thickness.
   d. Do not place frozen material or place material on frozen material.
   e. Do not place material when the temperature is below 32° F, or during periods of precipitation.
   f. If sections of a lift do not meet the minimum specified moisture content, those sections will be excavated, and either spoiled, or

placed in a separate area and sprayed and thoroughly mixed with additional water.

g. If sections of a lift exceed the maximum specified moisture content, those sections will be dried in any effective manner. If workable, this can be done without removal of the material.

h. If sections of a lift do not meet the minimum specified dry density, provide additional compaction in those sections until the density exceeds the specified minimum.

i. Finish each day's work with a smooth roller to create a smooth surface which will minimize moisture penetration.

j. At the beginning of each day, scarify or roughen the previously placed lift to promote bonding to the material to be placed above it.

k. Plan and conduct operations to prevent drying of compacted lifts.

l. Provide hand compaction at any confined area not accessible to normal equipment. Hand compacted material shall meet all specification requirements.

m. Incorporate excess material excavated from the Falls Creek construction site in cell embankments, as needed, of the Long Valley Run wetland treatment system. Remaining excess material generated from the construction sites is to be disposed at the location identified on the Drawings according to Technical Specification No. 14, "Erosion and Sedimentation Control."

3. Testing:

a. This testing will be performed on each compacted lift of Treatment Cell Embankment Material as it is being constructed. The testing performed on the completed lifts will be the basis for approval and acceptance.

b. The number of tests to be performed will be based on a spacing evenly distributed over each lift.

c. For each compacted lift the tests and maximum spacing are as follow:

(1) In-place moisture content and density tests on 100-foot centers performed in accordance with ASTM D-1556 or D-2167. Nuclear methods corresponding to ASTM D-2922 and D-3017 will be permitted only after field calibration of those methods with results from ASTM D-1556 or D-2167. Minimum performance requirements are dry density not less than 93 percent of the maximum dry density and moisture content within 4 percentage points of optimum moisture.

(2) Classification (includes liquid and plastic limits, and sieve and hydrometer analyses) on 200-foot centers (ASTM D-2487). All materials shall meet the materials specification.

4. At the Department's option, acceptance of completed lifts may be based upon non-movement of compaction equipment operating on the lift surface.

4.4 MEASUREMENT:

Grading, when satisfactorily completed and approved by the Department, will be measured by the number of cubic yards of material excavated at each site. Measurements will be obtained by field survey or by photogrammetric methods, at the discretion of the Department. The volume of excavation will be computed from cross sections utilizing the average end area method, based on horizontal measurement, or by any other three dimensional method determined by the Department to minimize error.

4.5 PAYMENT:

Payment for "Grading" will be made at the contract unit prices bid per cubic yard for "Site 1" and for "Site 2", which prices shall include full compensation for all labor, equipment and materials required to perform the work described. Any required overexcavation of acid-forming materials will be paid for as provided in Section 6.7, "Extra Work", of the General Conditions. No separate payment will be made for backfilling any required overexcavation.

No separate payment will be made for the construction of the treatment cell embankments or for hauling of material from Site 1 to Site 2. All costs, direct or incidental, for subgrade preparation, hauling, material placement, compaction, disking, watering, mixing, sloping, testing, and other necessary operations for construction of embankments, disposal of excess material, and stockpiling and spreading of topsoil shall be included in the appropriate contract unit prices bid per cubic yard for "Grading".

TECHNICAL SPECIFICATION NO. 5 - CHANNEL EXCAVATION

5.1 SCOPE:

The work covered by this section consists of the excavation required to construct channels in accordance with these specifications and in conformity to the lines and grades shown on the Drawings, or otherwise established by the Department.

5.2 PROCEDURE:

The Contractor shall construct the channels as shown on the applicable details and at the approximate locations shown on the Drawings. All material excavated shall be defined as unclassified excavation; that is, channel excavation shall include excavation of all material encountered.

No channel shall be constructed by the Contractor until its location is approved by the Department. The extent and location of channels may vary from what is shown on the Drawings depending on field conditions.

All excavated material from the channels shall either be placed on the low side of the ditch or incorporated into the fill areas, whichever is applicable, in accordance with the details on the Drawings.

Any acid-forming material encountered in the channel areas shall be overexcavated and backfilled as described under Technical Specification No. 4, "Grading".

The channels shall be maintained to the required cross section and shall be kept free from debris or obstructions until the project is accepted.

5.3 MEASUREMENTS:

Channel excavation, when satisfactorily completed and approved by the Department, will be measured by the number of cubic yards of material excavated as determined by the paylines shown on the Drawings. The volume of excavation will be computed from cross sections utilizing the average end area method.

5.4 PAYMENT:

Payment for "Channel Excavation" will be made at the contract unit price bid per cubic yard, which price shall include full compensation for all labor, equipment and materials required to perform the work described. Any required overexcavation of acid-forming materials will be paid for as provided in Section 6.7, "Extra Work", of the General Conditions. No separate payment will be made for backfilling any required overexcavation.

TECHNICAL SPECIFICATION NO. 6 - IMPERVIOUS LINING AND GEOTEXTILE FABRIC

6.1 SCOPE:

The work covered by this section consists of furnishing all labor, equipment, and materials, and performing all operations necessary in connection with the furnishing and placing of geotextile fabric and impervious geomembrane liner in close conformity to the elevations, lines and grades indicated on the Drawings, or as directed by the Department and in accordance with these specifications.

6.2 MATERIALS:

A. Geomembrane Liner - The geomembrane liner shall be linear low density polyethylene (LLDPE) material with a minimum thickness of 40 mils. The raw material shall be first quality polyethylene resin containing no more than two percent clean recycled polymer by weight, and the geomembrane shall conform to the following physical properties (min.):

Density, g/cc	0.915-0.930	ASTM D 1505

Carbon Black Content, %	2.0	ASTM D 1603
Carbon Black Dispersion, rating	A1, A2, B1	ASTM D 3015, NSF Mod.
Tensile Properties		ASTM D 638
100% Secant Modulus, psi	1,500	
Stress at Break, psi	3,800	
Strain at Break, %	680	2.5" gage length, (NSF)
Tear Resistance, ppi	630	ASTM D 1004
Puncture Resistance, ppi	1,950	ASTM D 4833
Multi-Axial Elongation, %	50	GRI GM4
Bonded Seam Strength, lb/in		ASTM D 4337 (as modified by NSF Standard 54, Appendix A)
Fusion	60	
Bonding	60	
Peel Adhesion, lb/in		ASTM D 4437 (as modified by NSF Standard 54, Appendix A)
Fusion	53	
Extrusion	45	

The liner shall be fabricated in the shop to the maximum practical width and length shown on the Drawings to minimize field seaming.

Where a seam is required for a continuous seal, it will be extrusion welded in the field with LLDPE produced from resin with the same physical properties as those of the resin used in the manufacture of the LLDPE membrane.

The finished geomembrane sheets shall be free from pinholes, surface blemishes, scratches or other defects.

Smooth LLDPE shall be used in lining the bottom of each treatment cell, and textured LLDPE shall be used to line treatment cell interior slopes. Textured LLDPE shall have a roughened surface on both sides.

B. Geotextile_Fabric - The geotextile fabric shall be a needle punched non-woven polypropylene or polyester fabric and conform to the following minimum properties:

Polymer Composition, % Polypropylene or Polyester	95	--
Weight, oz/yd^2	8.0	ASTM D 3776
Apparent Open Size, mm	0.120-0.210	ASTM D 4751
U.S. Sieve No.	70-120	ASTM D 4751
Permeability, cm/sec	0.3	ASTM D 4491
Grab Strength, lbs	200	ASTM D 4632
Trapezoidal Tear Strength, lbs	85	ASTM D 4533
Puncture Strength, lbs	140	ASTM D 4833
Mullen Burst Strength, lbs/in^2	450	ASTM D 3786
Thickness, mils	95	ASTM D 1777

6.3 PROCEDURES:

A. Foundation Preparation - Prior to the start of the geomembrane installation, the subgrade work shall be completed as specified herein and inspected by the Department. No geomembrane installation shall begin until approval has been granted by the Department. No geomembrane shall be placed on surfaces not previously found acceptable by the Department. Surfaces to be lined, shall meet the lines and grade shown on the Drawings. The intersections between planes shall be made along straight lines. Surfaces to be lined shall be smooth and free of all rocks, sharp stones, sticks, roots, sharp objects, or debris of any kind. The surface should provide a firm, unyielding foundation for the geomembrane with no sudden, sharp or abrupt changes or break in grade. If unsuitable foundation material is encountered, the Contractor shall excavate to a greater depth to the extent directed by the Department and backfill with suitable material. The geomembrane liner shall not be placed in frozen ground.

B. Berm Anchorage System - Excavate the anchor trench to the lengths and widths shown on the Drawings and in advance of the geomembrane material placement. If the anchor trench is excavated in a material susceptible to desiccation, no more than the amount of trench required for the geomembrane to be anchored in one day shall be excavated (unless otherwise specified) to minimize desiccation potential of

the anchor trench soils. Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane. No loose soil shall be allowed to underlie the geomembrane in the anchor trench.

C. General Requirements for Geomembrane Placement - Immediately prior to installation of the geomembrane liner, the soil surface (subgrade) shall be observed by the Department. The decision to repair cracks, if any, shall be made only by the Department. The subgrade shall be walked by the Installer and the Department for joint approval.

Field Panel Identification: A field panel is the unit area of geomembrane which is to be seamed in the field; i.e., a field panel is a roll or a portion of roll cut in the field. Identification Code: At the time of installation, give each field panel an identification code (number or letter-number) consistent with the layout plan and agreed upon by the Department.

Field Panel Placement: Install field panels at the location indicated in the layout plan (per requirements of Section 6.3.E) or as modified by the Department based upon existing site conditions. Field panels may be installed using any one of the following schedules:

a. All field panels are placed prior to field seaming (in order to protect the subgrade from erosion by rain or wind);
b. Field panels are placed one at a time, and each field panel is seamed immediately after its placement (in order to minimize the number of unseamed field panels); and
c. Any combination of the above.

Record the approval of the subgrade, date of installation of each field panel, its identification code, its roll number, its location, and its dimensions on the panel placement log form. Maintain an in-progress as-built drawing showing up to date locations of field panels.

D. Method of Geomembrane Placement - The installer shall verify the following:

1. That the equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons, or by such other means;
2. That the prepared surface underlying the geomembrane has not deteriorated since previous acceptance and is still acceptable immediately prior to geomembrane placement;
3. The geosynthetic elements immediately underlying the geomembrane are clean and free of debris;
4. That personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in such activities which could damage the geomembrane;

5. That the method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;
6. That the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
7. That the geomembrane is placed with the required slack to accommodate for thermal expansion as recommended by the manufacturer;
8. That adequate temporary loading and anchoring (e.g., sand bags, clean tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., by adjacent sand bags, or soil is recommended along edges of panels to minimize risk of wind flow under the panels); and
9. That direct contact with the geomembrane is minimized; i.e., the geomembrane, or other suitable materials in areas where excessive traffic may be expected, as well as under installation equipment such as compressors, welding equipment, etc.
10. The installer, through the Contractor, shall inform the Department if the above conditions are not fulfilled.

Inspect each panel after placement and prior to seaming for damage. Advise the Department which panels or portions of panels should be repaired or accepted. Mark damaged panels or portions of damaged panels which have been rejected, remove from the work area and record. Make repairs according to procedures described herein. Replace or repair a panel or section of panel for which the Department determines necessary to repair or replace under the responsibility and financial burden of the Contractor.

Passage of equipment over the finished surface of the liner, both prior to and after any cover placement, will not be permitted without specific approval of the Department.

E. Field Seaming

1. General: Provide the Department with a proposed panel layout drawing a minimum of 2 weeks prior to beginning the installation; i.e., a drawing of the facility to be lined based upon submitted engineering drawings. The proposed panel layout drawing is tentative and subject to the Department's approval.

   In general, orient seams parallel to the line of maximum slope; i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, minimize the number of seams. Construct no horizontal seam less than 5 feet (1.5 m) from the top or toe of the slope or areas of potential stress concentrations unless otherwise authorized by the Department. Where feasible, place upgradient panels over downgradient panels at the location of seams.

Use a seam numbering system compatible with a panel numbering system agreed upon at the Resolution and/or Pre-Construction Meeting.

The approved processes for field seaming are fillet (extrusion) welding and fusion (hot wedge) welding. Document proposed alternate processes and submit to the Department or its representative for approval.

a. Provide extrusion welding apparatus equipped with gauges giving the temperature of the apparatus at the nozzle.

b. Provide the fusion-welding apparatus with an automated vehicular-mounted device which produces a double seam with an enclosed space. A single wide seam is an acceptable substitute to the double seam.

c. Equip the fusion welding apparatus with gauges giving the applicable temperatures.

d. Verify that:

   1) Equipment used for seaming is not likely to damage the geomembrane;
   2) The extrusion welder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;
   3) The electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
   4) Buffing shall be completed no more than one (1) hour prior to extrusion welding;
   5) A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
   6) The geomembrane is protected from damage in heavily trafficked areas.

During Seam Preparation, verify that prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material; and that seams are aligned with the fewest possible number of wrinkles and fishmouths.

2. Fusion Welding:

a. Overlap the panels of geomembrane approximately four to six inches prior to welding. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt, debris of any kind. No grinding is required for fusion welding. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and fishmouths.

b. A movable protective layer may be used, directly below the overlap of geomembrane that is to be seamed to prevent buildup of moisture between the panels.

3. Extrusion Fillet Welding:
   a. Whenever possible, pre-bevel extrusion welded seams prior to heat-tracking into place.
   b. Overlap the panels of geomembrane a minimum of six inches. Temporarily bond the panels of geomembrane to be welded taking care not to damage the geomembrane.
   c. Grind seam overlap prior to welding within one hour of the welding operation in a manner that does not damage the geomembrane. Cover all grind marks with extrudate. Do not extend grinding more than one-quarter inch past the edge of the area covered by the extrudate during welding. Perform grinding by a seaming technician or a technician-in-training.
   d. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt, and debris of any kind.
   e. Purge the extruder prior to beginning the seam to remove all heat-degraded extrudate from the barrel. Place the purged extrudate on scrap material so as to prevent contact with good liner. Keep welding rod clean and dry.
4. Weather Conditions for Seaming:
   a. Unless authorized in writing by the Department, attempt no seaming at ambient temperatures below 40 degrees F or above 104 degrees F (40°C). At ambient temperatures between 40 degrees F and 50 degrees F, seaming shall be allowed if the geomembrane is preheated to a surface temperature of 50°F by either sun or hot air device, and if there is no excessive cooling resulting from wind. At ambient temperatures above 50 degrees F, no preheating shall be required. In all cases, the geomembrane shall be dry and protected from wind damage.
   b. If the Installer wishes to use methods which may allow seaming at ambient temperatures below 40 degrees F or above 104 degrees F, he shall demonstrate that the seam so produced is equivalent to those produced under normally approved conditions, and that the overall quality of the geomembrane is not adversely affected. In addition, the Contractor shall provide written certification to the Department which specifically states that the seaming procedures do not cause any physical or chemical modification to the geomembrane that will generate any short or long-term damage to the geomembrane.
   c. Do not weld during any precipitation, in the presence of excessive moisture, in an area of ponded water, or in the presence of excessive winds.

F. Testing Seams - Construct test seams made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Construct test seams made at the beginning of each seaming period (start of day, mid-day, and anytime

equipment is shut down) for each seaming apparatus used. Additionally each seamer will make at least one test seam each day. At the Department's direction, one additional test seam per day may be required if just cause exists. Construct test seams under the required conditions as actual seams.

1. Construct the test seam samples a minimum of three feet long by one foot wide (after seaming) with the seam centered lengthwise. Provide seam overlaps a minimum of four to six-inches.
2. Cut six specimens each one inch (25 mm) wide from the test seam sample by the Installer. (One from each end and four from the middle of the sample). Test the specimens in peel using a field tensiometer, to verify they exhibit a film tearing bond (FTB) and meet the requirements of destructive test samples. For fusion welds test both sides of the weld in peel. If the specimen fails, repeat the entire operation. If the additional specimen of the retest fails, do not use the seaming apparatus and seamer until the deficiencies are corrected and two consecutive successful full test welds are achieved.
3. Record date, time, operator, machine number, ambient and operating temperatures, speed setting, peel values and pass/fail designation on a trial weld form.
4. Whenever required by the Department, cut a test strip (field bone) at the end of a seam. Test the field bone's (one inch wide) peel. These peel tests shall meet the minimum requirements of those specified for Destructive Testing. The Department may request additional trial welds based on the results of these tests. In the event of a failing field bond, the welding machine will be taken out of service until a passing trial weld is obtained. Additional field bones will be taken to localize the deficient weld in the same manner.

G. Reporting - Complete a field welding log for all panel seaming and all repairs. Provide the following information: date, time, seam number, panel numbers, seam length or repair location, size and type, seamer initials, machine number, weather and ambient temperature, extradite or wedge temperature, and the result of any on-site destructive tests taken from the weld. If ambient temperatures are below 50°F, or if excessive cooling winds necessitate preheating of the liner, the geomembrane surface temperature must also be documented.

H. Defects and Repairs - Examine seams and non-seam areas of the geomembrane identification for defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Document this information and submit to the Department in a Damage/Repair Report. Nondestructive test each suspect location both in seam and non-seam areas using the methods described previously as appropriate. Mark each location which fails the non-destructive test, and repair and retest each location. Work shall not proceed with any materials which will cover locations which have been repaired until laboratory test results with passing values are available.

Satisfy the following prior to making repairs:
a. Abrade surfaces of the geomembrane which are to be repaired no more than one hour prior to the repair;
b. Surfaces must be clean and dry at the time of the repair;
c. Use approved seaming equipment for repairs;
d. Use repair procedures, materials, and techniques approved by the Department in advance of the specific repair.
e. Extend patches or caps at least 6 inches beyond the edge of the defect. Round the corners of patches with a radius of at least three inches, and bevel the edges of the patch.
f. Placing an extrusion weld over a failed fusion weld will not be considered an acceptable repair method. Cap strip all failed welds.

Repair any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure will be subject to the Department's approval. The procedures available include:
a. Patching: Used to repair large holes, tears, and contamination by foreign matter;
b. Buffing and Re-welding: Used to repair small sections of extruded seams;
c. Spot Welding or Seaming: Used to repair small tears, pinholes, or other minor localized flaws;
d. Capping: Used to repair large lengths of failed seams;
e. Topping: Used to repair areas of inadequate seams which have an exposed edge.

Identify each major repair requiring a patch or cap on the record drawing. Non-destructively test each repair using the methods described previously as appropriate. Repairs which pass the nondestructive test will be taken as an indication of an adequate repair. Repair failed tests and re-test until a passing test results. Documentation: all documentation for quality control testing shall be submitted to the Department, and the Geomembrane Manufacturer.

I. Protection and Maintenance of Geomembrane Liner - If in the placement of the layers of material which cover the geomembrane (i.e., geotextile, AASHTO No. 57 Limestone, filter fabric, spent mushroom compost, and the PVC underdrain system, the Contractor damages or displaces the liner material, the Contractor shall be required to remove and replace the cover and/or liner material to the satisfaction of the Department.

J. Method of Geotextile Placement - Handle geotextile in such a manner as to ensure it is not damaged in any way. In the presence of wind, weight the materials with sandbags or approved equivalent until final covers are installed. Take care to insure that any underlying layers are not damaged during placement of geotextiles.

Take care to insure that stones, mud, and dirt are not entrapped in the geotextile during placement and seaming operations.

Install geotextile by overlapping and continuously sewing with a prayer stitch. Provide thread manufactured from polymeric material with chemical resistance similar to the geotextile. Locate lost or broken sewing needles and recover using a metal detector, if necessary.

Repair by patching any holes or tears in geotextile with the same geotextile. Provide a patch a minimum of 12 inches larger in all directions than the area to be repaired and sew in place.

K. Placement of Cover Material - Place cover material (AASHTO No. 57) over the geotextile according to procedures specified in Section 9.3 and in such a manner as to assure that the underlying geotextile and geomembrane are not damaged. Take care to minimize any slippage of the geotextile and geomembrane and to assure that no tensile stress is induced in the materials. Do not drive equipment used for placing cover material directly on the geotextile or geomembrane.

6.4 MEASUREMENT:

Impervious lining and geotextile fabric, when satisfactorily completed and approved by the Department, will be measured by the number of square yards in place at each site as determined by the paylines shown of the Drawings.

6.5 PAYMENT:

Payment for "Impervious Lining and Geotextile Fabric" will be made at the contract unit prices bid per square yard for "a) Smooth LLDPE, Site 1" and "Site 2", for "b) Textured LLDPE, Site 1" and "Site 2", and for "c) Geotextile Fabric, Site 1" and "Site 2", which prices shall include full compensation for furnishing all labor, equipment and materials required to perform the work described. Payment for placement of cover material (AASHTO No. 57) will be made under the Technical Specification entitled "Wetland Treatment Unit Material".

TECHNICAL SPECIFICATION NO. 7 - MAINTENANCE ROAD

7.1 SCOPE:

The work covered by this section consists of the construction of a crushed stone surface maintenance road in conformity to the dimensions and typical section shown on the Drawings and the installation of 18-inch diameter HDPE culverts.

7.2 MATERIALS:

A. General - The Contractor shall supply all materials necessary for the construction of the crushed stone surface maintenance road. All material shall be furnished by suppliers who are approved by the Department.

B. Sub-base - Sub-base material shall consist of select granular material (2RC) conforming to PennDOT Publication 408, Section 703.3.

C. Pipe Bedding for Trenches - Aggregate conforming to AASHTO No. 8 Coarse Aggregate, PennDOT Publication 408, Section 703.2.

D. Initial Backfill - Aggregate conforming to AASHTO No. 8 Coarse Aggregate, PennDOT Publication 408, Section 703.2.

E. High Density Polyethylene Corrugated Pipe (HDPE) - Provide pipe and fittings manufactured from polyethylene compounds which meet or exceed the requirements of Type III, Category 4 or 5, Graded P33 or P34, Class C according to ASTM D-1248. Clean reworked material may be incorporated into the compounds.

1. Pipe and fittings showing visible defects and foreign inclusions in the material are not acceptable.
2. Pipe lengths shall have cleanly and squarely cut ends so as not to adversely affect pipe joining.
3. Provide corrugated fittings (corrugation shall match the pipe) of either molded or fabricated type. Fittings by other than the pipe manufacturer are not acceptable.
4. Joints: Split coupling type end of a corrugated design to engage the pipe corrugations for a minimum of four corrugations, two on each side of the pipe joint.
5. Gaskets: Provide neoprene sponge gaskets on each pipe joint where pipe is installed under roadway embankments. Insert the gasket under the coupling on each side of the pipe joint.

7.3 PROCEDURE:

A. General - The site of the roadway shall be prepared in accordance with Technical Specification No. 2, "Clearing and Grubbing".

B. Dust Control - Exercise the necessary means and methods to control dust on the site during the roadway excavation backfill and compaction work.

C. Grading - Perform grading and construct roadway embankments according to Technical Specification No. 4, "Grading".

D. Subgrade Preparation - Compact subgrade prior to roadway sub-base construction. Remove any soft, wet or otherwise unsuitable material to the limits directed by the Department. Compact subgrade to a minimum final density of not less than 95 percent of the maximum dry weight density at its optimum moisture content. Perform finish rolling on roadway subgrade just prior to installation of aggregate sub-base.

E. Sub-base Construction - Install sub-base to the compacted thickness as shown on the Drawings. Compact the uniformly spread material to a final in-place density based on non-movement of the material under the Compaction equipment. Proceed with compaction gradually from sides to center, with each successive pass uniformly overlapping the previous pass. Continue compaction operations until the entire area is satisfactorily shaped and compacted.

F. Culvert Installation - Install HDPE culverts in accordance with ASTM D 2321 using AASHTO No. 8 for pipe bedding and initial backfill. Provide minimum spacing of 12 inches between the outside walls of the twin 18-inch diameter HDPE culverts.

7.4 MEASUREMENT:

Maintenance road will be measured by the number of square yards of 2RC granular material satisfactorily placed and approved by the Department and by the number of linear feet, as measured along the centerline, of 18-inch diameter HDPE culverts satisfactorily installed and approved by the Department.

7.5 PAYMENT:

Payment will be made at the contract unit price bid per square yard for "Maintenance Road, a) 2RC Granular Material", which price shall include full compensation for all labor, equipment, materials and incidentals required to perform the work described. Payment for clearing and grubbing the maintenance road route will be made under the Technical Specification entitled "Clearing and Grubbing". Payment for grading the maintenance road embankments will be made under the Technical Specification entitled "Grading".

Payment will be made at the contract unit price bid per linear foot for "Maintenance Road, b) 18-Inch Diameter HDPE Culverts", which price shall include trench excavation, pipe bedding, compacted backfill, labor, equipment, materials and incidentals to perform the work described.

TECHNICAL SPECIFICATION NO. 8 - ROCK LINING

8.1 SCOPE:

The work covered by this section consists of furnishing all plant, labor, equipment and materials, and performing all operations in connection with the construction of rock-lined slope protection measures, as shown on the Drawings or as directed by the Department.

8.2 MATERIALS:

A. General - The Contractor shall supply all materials necessary for the construction of rock lining with geotextile to be placed in stormwater ditches and on treatment cell side slopes as specified on Drawings. All sources must be approved by the Department and shall meet the specifications given in the following paragraphs.

B. Geotextile - Geotextile shall be Class 2, Type A, meeting the requirements of Section 735.1 of the current Pennsylvania Department of Transportation Specifications, Publication 408.

C. Rock - Rock shall meet the quality and gradation requirements of Section 850.2(a) of the current Pennsylvania Department of Transportation Specifications, Publication 408, for R-3 and R-4 Rock Lining. The nominal placement thickness of the rock lining layer shall be as shown on the Drawings.

8.3 PROCEDURE:

A. Foundation Preparation - Areas on which rock lining is to be placed shall be trimmed and dressed to conform to cross sections shown on the Drawing. Where such areas are below grade, they shall be brought to grade by filling with suitable material. The cell side slopes are excluded from this requirement.

B. Geotextile Fabric - After the foundation has been satisfactorily prepared, the Contractor shall then place thereon a geotextile fabric meeting the specifications of Section 8.2B. The fabric shall be installed longitudinally along the direction of flow. Whenever more than one section of fabric is required, the fabric must be overlapped approximately one (1) foot to assure continuity. The fabric shall be anchored in a satisfactory manner to prevent displacement. Special care shall be exercised in placing rock on the fabric. If the fabric is damaged prior to or during placement of rock upon it, all material shall be removed from the damaged area and a patch of fabric large enough to cover the damaged section, including a one (1) foot overlap, shall be placed on top of the damaged section. Interior treatment cell side slopes, lined with LLDPE and geotextile protection which is paid under Technical Specification No. 6, "Impervious Lining and Geotextile", are excluded from this requirement for geotextile fabric.

C. Rock Lining - Rock shall be placed on the geotextile fabric in such manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and shall be constructed to the lines and grades shown on the Drawings or as staked in the field.

Fines shall be well distributed in order to chink the voids between large pieces insofar as practicable.

Rock lining shall be placed to its full course thickness at one operation and in such manner as to avoid displacing the underlaying material. Placing rock in layers will not be permitted. The larger stones shall be well distributed and the entire mass of stones shall be roughly graded to conform to the gradation specified in Section 8.2C. The finished rock lining shall be free from objectionable pockets of small stones and clusters of larger stones. Hand placing to a limited extent may be required, but only to the extent necessary to secure the results specified.

The use of a tractor equipped with a bulldozer blade, stone rake, or any similar equipment will not be acceptable for placement of rock.

The rock lining shall have the placement thickness indicated on the Drawings. The finished surface of the rock lined slope protection shall be in accordance with the lines and grades shown on the Drawings. The Contractor shall maintain the rock lined slope protection until accepted, and any material displaced through the fault or negligence of the Contractor shall be replaced at his expense. Passage of equipment over the finished surface will not be allowed without specific approval of the Department.

8.4 MAINTENANCE:

The Contractor shall maintain and make all necessary repairs to all slope protection areas for the duration of the contract.

8.5 MEASUREMENT:

Rock lining, when satisfactorily completed and approved by the Department, will be measured by the number of square yards of rock-lined slope protection in place at each site, as determined by the paylines shown of the Drawings.

8.6 PAYMENT:

Payment for "Rock Lining" will be made at the contract unit prices bid per square yard for "a) R-3 Rock, Site 1" and "Site 2", for "b) R-3 Rock with Geotextile, Site 1" and "Site 2", and for "c) R-4 Rock with Geotextile, Site 1" and "Site 2", which prices shall include full compensation for all labor, equipment, materials and incidentals required to perform the

work described. No additional payment will be made for any increases in thickness that may be required for transitions or cutoffs.

TECHNICAL SPECIFICATION NO. 9 - WETLAND TREATMENT UNIT MATERIAL

9.1 SCOPE:

The work covered by this section consists of furnishing all labor, equipment and materials necessary for the placement of the AASHTO No. 57 Limestone and Spent Mushroom Compost in passive treatment cells at the locations and to the dimensions shown on the Drawings. The time of the placement may be selected by the Contractor who shall be responsible for securing a satisfactory supply and amount of each material. Placement of materials should be performed as soon as possible following installation of the LLDPE liner and geotextile fabric in each treatment cell.

9.2 MATERIALS:

The Contractor shall furnish all of the material specified. Unless stated otherwise in the following paragraphs, all sampling and testing of these materials will be at the direction of the Department and at the Contractor's expense. All material shall be furnished by suppliers who are approved by the Department.

A. AASHTO No. 57 Limestone - The material shall meet the gradation requirements of Section 703.2(c) of the current Pennsylvania Department of Transportation Specifications, Publication 408 and shall contain not less than ninety percent (90%) calcium carbonate equivalent ($CaCO_3$ equivalent) and not more than five percent (5%) magnesium oxide (MgO).

B. Spent Mushroom Compost - The material shall be carefully selected to minimize foreign material (e.g., cans, glass, medical materials) that may puncture and tear the LLDPE liner and pose public health risk. The spent mushroom compost shall contain a maximum of one percent foreign. A spent mushroom compost supplier, Campbell's Mushrooms in Evansville, Pennsylvania (Peter Johnson, 610-926-4101), has been identified as a source for this project. Alternative spent mushroom compost suppliers may be utilized by the Contractor if the compost meets the foreign material specification and with the approval of the Department.

9.3 PROCEDURES:

After the treatment cells have been constructed and the LLDPE liner and geotextile fabric have been satisfactorily installed and approved by the Department, the Contractor shall place thereon, layers of the AASHTO No. 57 Limestone, Filter Fabric, and Spent Mushroom Compost at the locations and to the dimensions shown on the Drawings.

To prevent damage to the LLDPE liner, the Contractor shall place the first two (2) inches of limestone on the liner by hand. The slotted underdrain shall be placed on top of the 2-inch layer of limestone according to procedures in Section 11.3. The Contractor shall place the remainder of the limestone according to procedures specified in Section 11.3, covering the underdrain piping, to the specified depths on the Drawings.

To prevent migration of spent mushroom compost into the limestone, filter fabric shall be placed between the limestone and compost layers according to procedures in Section 10.3.

9.4 MAINTENANCE:

The Contractor shall maintain and make all necessary repairs to the materials for the duration of the contract.

9.5 MEASUREMENT:

Wetland treatment unit material, when satisfactorily completed and approved by the Department, will be measured by the number of tons of AASHTO No. 57 limestone and the number of cubic yards of spent mushroom compost in place at each site, to the dimensions shown on the Drawings.

9.6 PAYMENT:

Payment for "Wetland Treatment Unit Material" will be made at the contract unit prices bid per ton for "a) AASHTO No. 57 Limestone, Site 1" and "Site 2" and per cubic yard for "Spent Mushroom Compost, Site 1" and "Site 2", which prices shall include full compensation for all labor, equipment, materials and incidentals required to perform the work described. Payment for placement of filter fabric will be made under the Technical Specification entitled "Filter Fabric".

TECHNICAL SPECIFICATION NO. 10 - GEONET

10.1 SCOPE:

The work covered by this section consists of furnishing all labor, equipment, and materials, and performing all operations necessary in connection with the furnishing and placing of geonet in close conformity to the elevations, lines and grades indicated on the Drawings, or as directed by the Department and in accordance with these specifications.

10.2 MATERIALS:

A. General - The Contractor shall supply all material necessary for the installation of geonet between the AASHTO No. 57 Limestone layer and the Spent Mushroom Compost layer.

B. Geonet - The material shall be a profiled mesh manufactured by extruding two sets of strands together to form a diamond-shaped net and conforming to the following minimum average roll values::

Weight, lbs/ft^2	0.162	ASTM D 5261
Thickness, inches	0.200	ASTM D 5199
Polymer Density, g/cm^3	80	ASTM D 1505
Carbon Black Content, %	2	ASTM D 1603
Melt Flow Index, g/10 min	1.0 Max.	ASTM D 1238
Tensile Strength, lbs/in	42	ASTM D 5035
Porosity, % (nominal)	80	--
Transmissivity, m^2/s (gradient = 1.0 at 15,000 psf)	0.001	ASTM D 4716

10.3 PROCEDURE:

A. General Requirements - Handle geonet materials in such a manner as to ensure they are not damaged in any way. In the presence of wind, weight the materials with sandbags or approved equivalent until final covers are installed. Take care to insure that any underlying layers are not damaged during placement of the geonet. Take care to insure that stones, mud, and dirt are not entrapped in the geonet during placement and seaming operations.

B. Installation - Anchor the geonets at the cell embankments and unroll toward the center of the treatment cells. Install geonets by overlapping and tying on every edge. Provide all nylon cable ties necessary for the entire system installation.

1. Connect adjacent rolls using nylon cable ties applied to the net edge at 5-foot intervals. Overlap net edges a minimum of 4 inches.
2. Make end splices by overlapping the ends a minimum of 6 inches and connect with one row of cable ties spaced a 6-inch intervals.

C. Repairs - repair any holes or tears in geonets by patching with the same geonet material. Provide a patch a minimum of 12 inches larger in all directions than the area to be repaired and tie the patch in place using a minimum of four nylon cable ties.

10.4 MEASUREMENT:

Geonet, when satisfactorily completed and approved by the Department, will be measured by the number of square yards of geonet in place at each site, as determined by the paylines shown of the Drawings.

10.5 PAYMENT:

Payment for "Geonet" will be made at the contract unit prices bid per square yard for "Site 1" and for "Site 2", which prices shall include full compensation for all labor, equipment, materials and incidentals required to perform the work described.

TECHNICAL SPECIFICATION NO. 11 - PIPING

11.1 SCOPE:

The work covered by this section consists of furnishing all labor, equipment and materials and performing all operations in connection with the installation of the polyvinyl chloride (PVC) leachate collection system, the PVC cell bypass pipes, the bypass pipe systems, and associated structures, fittings, valves, and riser and end sections.

11.2 MATERIALS:

A. General - The Contractor shall furnish all of the materials specified. All materials shall be furnished by suppliers who are approved by the Department.

B. 4-Inch Diameter PVC Slotted Underdrain Collection Pipe - The pipe shall conform to ASTM D-1785, Schedule 80, manufactured from Class 12454-B Rigid PVC compounds (ASTM D-1784) designated as PVC 1120. Joints to be deep socket integral solvent weld bell and spigot type. Socket type fittings shall be unperforated conforming to ASTM D-2467, Schedule 80, manufactured from Class 12454-B Rigid PVC Compound (ASTM D-1784). Pipe is to be slotted with two rows of 2.6-inch-long slots with a slot width of 0.100 inch, spaced at 0.50 inch as shown on the Drawings.

C. 8-Inch Diameter PVC Leachate Header and Flow Bypass Pipe - The pipe shall conform to ASTM D-1785, Schedule 80, manufactured from Class 12454-B Rigid PVC compounds (ASTM D-1784) designated as PVC 1120. Joints to be deep socket integral solvent weld bell and spigot type. Socket type fittings shall conform to ASTM D-2467, Schedule 80, manufactured from Class 12454-B Rigid PVC compound (ASTM D-1784).

D. 12-Inch Diameter PVC System Bypass Pipe and Fittings - The pipe shall be solid wall and conform to the requirements of ASTM D 3034, Type PSM SDR-26. Fittings shall conform to the same applicable ASTM Specification requirements for

pipe. Joints shall be push-on with elastomeric gasket, ASTM D-3212 and ASTM F-477 for gasket specifications. Pipe bell shall incorporate a gasket locked in a groove so as to prevent displacement when pipes are joined.

E. PVC Pipe Solvent - Solvent conforming to ASTM D 2564.

F. Pipe Bedding for Trenches - Aggregate conforming to AASHTO No. 8 Coarse Aggregate, PennDOT Pub. 408, Section 703.2.

G. 12-Inch Diameter DIP Bypass Pipe - Pipe shall conform to the requirements of ANSI A21.50 and ANSI A21.51. Fittings shall be gray iron or ductile iron conforming to the requirements of ANSI A21.10. Joints shall be flanged conforming to ANSI A21.15 with gaskets conforming to ANSI B16.21.

H. Valve Box - Made of cast iron consisting of a base, extension section, top section and cover.

I. 12-Inch Gate Valves - The valves shall be designed for a working water pressure of 200 psi and be of the rising stem type except when installed underground. Valve shall have iron body, outside screw and yoke, bronze mounted with resilient-seated wedge conforming to AWWA C-509. Resilient seat of SBR or Urethane Rubber bonded to cast iron wedge and an "O"-ring type stem seal. The exterior of the valve shall be asphalt varnish or epoxy coated and the interior ferrous metal parts shall be epoxy coated conforming to AWWA C-550. Valve ends shall be flanged conforming to ANSI B16.1.

J. Flexible Pipe Coupling - Coupling shall conform to ASTM C-594-70 with 305 stainless steel bands.

K. Precast Concrete Inlet Box - Conforming to the requirements of the current Pennsylvania Department of Transportation Specifications, Publication 408, Section 605 and Publication 72, RC-34. Reinforced opening in inlet with reinforcement bars conforming to ASTM A-615. Reinforced walls and bottom with welded wire fabric conforming to ASTM A-185. Cast steel angle in top of inlet to hold grate.

L. Inlet Frame and Grate - Provide grate of design indicated and fabricated of structural steel bar and angle with angle frame.

M. 12-Inch PVC Bypass Pipe Screen - The screen shall be No. 316 stainless steel. If expanded metal is used the openings shall be ½ by 1½ inch diamonds and fabricated from 10 gauge thickness stainless steel. Wire cloth shall be double-crimp type of one inch fabricated from 0.1350 inch diameter stainless wire. The ring collar for either screen type shall be a minimum of three inches wide and

fabricated from 10 gauge thickness stainless sheet. The through-pin lock-on device shall be at least ⅜ inch diameter stainless rod with clevis-pin stays on both ends.

N. Non-Shrink Non-Metallic Grout - A factory premixed material containing no corrosive irons, aluminums, chemicals or gypsums and complying with the following limitations:

1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent sand cement and water mix when tested according to ASTM C 596.
2. Grout shall exhibit no shrinkage before initial set and show no expansion after set when tested according to ASTM C 827.
3. Initial set of grout shall occur in not less than 60 minutes according to ASTM C 191 Test.
4. Use Type II (Sulfate Resistant) cement.

11.3 PROCEDURES:

A. Leachate Collection System and Flow Bypass Pipes - The leachate collection system and flow bypass pipes shall be installed by the Contractor after the subgrade is prepared and the cell liner and 2-inch AASHTO No. 57 limestone base layer is placed.

The Contractor shall install the 8-inch leachate discharge headers and 4-inch leachate collection laterals, and 8-inch flow bypass pipes in each treatment cell as shown on the Drawings. The piping shall be cut and cemented together in accordance with the pipe manufacturers written detailed instructions. The Contractor shall not deviate from those instructions. Following the installation of the headers, laterals and bypass pipe, the Contractor shall hand place the aggregate around the piping in order not to damage the piping or disturb the alignment. After placement of material in the treatment systems the flow bypass risers, shown on the Drawings, shall be installed on the 8-inch flow bypass pipes. Orifice outlet controls shall also be installed on the outlet of each leachate collection and flow bypass pipe according to the Schedules on the Drawings.

B. Falls Creek Bypass System - The Contractor shall install the Falls Creek (Site 1) treatment system 12-inch bypass pipe by excavating a trench. The excavation shall begin in the trench at the central point having the lower invert and proceeding upgrade. Removed material shall be separated and stored to be used as backfill or other purposes.

Lay pipe with the ball end on the upstream end. Rest each section of pipe on bedding for the full length of its barrel. Make recesses to facilitate pipe joint making. Backfill recesses with bedding material immediately following pipe joining operations. Backfill trench to a height at least one foot above the top of the

outside barrel of the pipe with pipe bedding material placed in four inch layers. Refill remainder of the trench using backfill material compacted in six inch layers.

Install the bypass pipe inlet system with gate shut-off valve as shown on the Drawings and according to the manufacturer's literature.

Install a screen guard on both the intake and outlet of the 12-Inch PVC Bypass Pipe. The screens may be of either expanded metal or wire cloth. In either case the screen shall be permanently attached to a ring collar that is sized to slip-fit the pipe exterior. The ring collar shall be equipped with a through-pin lock-on device of such design to be removed without tools and non-threaded.

B. Long Valley Run Bypass System - The Contractor shall install the Long Valley Run (Site 2) treatment system 12-inch bypass pipe by excavating a trench. The excavation shall begin in the trench at the central point having the lower invert and proceeding upgrade. Removed material shall be separated and stored to be used as backfill or other purposes.

Lay pipe with the ball end on the upstream end. Rest each section of pipe on bedding for the full length of its barrel. Make recesses to facilitate pipe joint making. Backfill recesses with bedding material immediately following pipe joining operations. Backfill trench to a height at least one foot above the top of the outside barrel of the pipe with pipe bedding material placed in four inch layers. Refill remainder of the trench using backfill material compacted in six inch layers.

Set precast inlet structure on undisturbed or well compacted earth. Install gate valve as shown on the Drawings and according to the manufacturer's literature. Fill annular space between pipe and inlet opening for the pipe with non-shrink non-metallic grout. Cut bars in grate to provide opening for top of gate valve.

Install a screen guard on the outlet of the 12-Inch PVC Bypass Pipe. The screen may be of either expanded metal or wire cloth. In either case the screen shall be permanently attached to a ring collar that is sized to slip-fit the pipe exterior. The ring collar shall be equipped with a through-pin lock-on device of such design to be removed without tools and non-threaded.

11.4 MEASUREMENT:

Leachate collection systems and 8-inch bypass pipes at each site, the Falls Creek (Site 1) 12-inch bypass pipe system, and the Long Valley Run (Site 2) 12-inch bypass pipe system will each be considered and measured as a job.

11.5 PAYMENT:

Payment for "Piping" will be made at the contract lump sum prices bid for "a) Leachate Collection Systems and 8-inch Bypass Pipes, Site 1" and "Site 2" and for "b) 12-inch Bypass Pipe System, Site 1" and "Site 2", which prices shall include full compensation for all labor, equipment, materials and incidentals required to perform the work described for each item and as shown on the Drawings. All costs for trench excavation, backfill, compaction, sheeting and shoring, pipe fittings, bends, valves and assemblies, end sections, concrete inlet structure, and any other related work and materials will be considered incidental to the appropriate lump sum prices bid for "Piping", and no separate payment will be made.

TECHNICAL SPECIFICATION NO. 12 - SEEDING

12.1 SCOPE:

The Contractor shall seed all areas within the limits of seeding excluding the wetland treatment surface areas which shall be planted in accordance to Technical Specification No. 13. The work covered by this section consists of scarifying of the seed bed, furnishing and placing pulverized agricultural limestone, commercial fertilizer, seed, mulching, and maintaining the seeded areas. The time of seeding may be selected by the Contractor who shall be responsible for securing a satisfactory stand of grass. Seeding should be performed as soon as possible following the completion and approval of final grading, and the incorporation of soil supplements. If erosion occurs between the time of final grading and time of seeding, the Contractor shall replace the fine soil materials which were eroded away and regrade all eroded areas to reestablish the final grade. The Contractor shall also reapply and reincorporate soil supplements in the eroded areas. The Contractor may, with the approval of the Department, perform temporary seeding operations in order to maintain finished graded areas until the optimum time for performing permanent seeding.

12.2 MATERIALS:

The Contractor shall furnish all of the materials specified. Unless stated otherwise in the following paragraphs, all sampling and testing of these materials will be at the direction of the Department and at the Contractor's expense. All materials shall be furnished by suppliers who are approved by the Department.

A. Grass Seed - Grass seed shall consist of the following mixtures:

TYPE 1 - FOR AREAS FLATTER THAN 3:1 SLOPE

	Maximum Weed Seed Percent	Minimum Purity Percent	Minimum Germination Percent	Minimum Quantity of Seed Lbs./Acre
Tall Fescue	0.25	95	80	35

(Johnstone, Fawn, or equal var.)				
Red Top ("Common Seed")	--	92	80	5
Birdsfoot Trefoil (Empire Var.)	0.25	98	75*	10
TOTAL POUNDS PER ACRE				50

* Minimum 50% Ready Germination, 25% Hard Seed.

TYPE 2 - FOR AREAS OF 3:1 SLOPE AND STEEPER

	Maximum Weed Seed Percent	Minimum Purity Percent	Minimum Germination Percent	Minimum Quantity of Seed Lbs./Acre
Tall Fescue (Johnstone, Fawn, or equal var.)	0.25	95	80	25
Crown Vetch (Penngift Var.)	0.10	99	70*	25
TOTAL POUNDS PER ACRE				50

* Minimum 35% Ready Germination, 35% Hard Seed.

Subject to the approval of the Department, the Contractor may add other grass seeds to the mixture to secure a cover crop, but no additional payment will be made therefor.

No seed shall contain any of the following noxious weed seeds: Canada Thistle, Field Bindweed, Johnson Grass, Perennial Peppergrass, Perennial Sowthistle, Quackgrass, Horse Nettle, Bedstraw, Corncokle, Brassica Kaber, Brassica Nigra, Wild Onion or Wild Garlic.

All seed shall conform to the Pennsylvania Seed Act of 1965, Act No. 187, as amended, and regulations of the Pennsylvania Department of Agriculture, Bureau of Plant Industry.

Certification of purity and germination analysis must be supplied under the current Rules for Testing Seeds of the Association of Official Seed Analysis by the Commonwealth of Pennsylvania, Department of Agriculture, Bureau of Plant Industry.

Seed shall be furnished fully tagged and delivered by separate varieties, separately packaged or bagged. All pre-mixed seed shall have an inspection tag, stamped, dated and signed by the Department Inspector, sewn into the inside top of each bag. No seed shall be utilized which has a mix date older than nine (9) months.

No seed shall be used on any project unless it has been inspected and sampled as described, or sampled by individual species and mixed on the project under Department supervision.

The seed furnished shall not be more than two (2) years old and shall have been tested for germination not more than six (6) months prior to seeding operations. A certificate of test results shall be furnished to the Department before approval for use of the seed is given.

B. Inoculant - The inoculant for treating leguminous seed (vetch, clover, trefoil, etc.) shall be a standard commercial product consisting of a suitable carrier containing a culture of nitrogen fixing bacteria specific for the seed to be inoculated. All containers must remain sealed until contents are used in their entirety. Inoculant shall not be used after the expiration date indicated on the container.

Suitable storage in a moderate temperature shall be provided at all times. All inoculant shall be subject to approval of the Department.

C. Commercial Fertilizer - Commercial fertilizer shall be uniform in composition, free-flowing material suitable for application with approved standard equipment. The commercial fertilizer shall conform to applicable Commonwealth fertilizer laws and shall be delivered in bags or other convenient containers each fully labeled and bearing the name, trademark, and warranty of the producer.

D. Pulverized Agricultural Limestone - Pulverized agricultural limestone shall be agricultural ground limestone and shall contain not less than eighty-nine percent (89%) calcium carbonate equivalent ($CaCO_3$ equivalent) and be ground to such fineness that at least ninety-five percent (95%), sixty percent (60%) and fifty percent (50%) by weight will pass standard twenty (20), sixty (60) and one hundred (100) mesh sieves, respectively. If moisture content exceeds five percent (5%), the maximum percentage of moisture shall be clearly indicated and the application rates shall be adjusted accordingly to reflect moisture content. Such limestone shall contain a minimum of ten percent (10%) magnesium as MgO or a supplemental amount of magnesium (Mg) shall be applied with the limestone to achieve a total minimum equivalent application rate of 400 lbs./acre as MgO.

E. Mulching Materials - All mulching materials shall be free from mature seed-bearing stalks or roots of prohibited of noxious weeds as defined in the Pennsylvania Seed Act of 1965, Act No. 187.

Mulches for seeded areas shall be either hay or straw, or a combination of both.

Hay or straw mulching material shall be well cured to less than twenty percent (20%) moisture content by weight, and shall contain no stems of tobacco, soybeans, or other coarse or woody material.

1. Hay - This shall consist of Timothy hay, mixed clover and Timothy hay, or other approved native or forage grasses.
2. Straw - Straw mulching material shall be either wheat or oat straw reasonably free of viable seed.
3. Binder materials:
    a. Asphaltic emulsion shall consist of refined petroleum asphalt emulsified in alkaline water without the use of clay, starch, or like deleterious substances and not more than 0.75% of saponified acids. It shall be of a fluid consistency suitable for spray application. It shall contain no petroleum solvents or other diluting acids known to be toxic to plant life, or,
    b. Non-asphaltic emulsion consisting of natural vegetable gum blended with gelling and hardening agents (Az-Tac) as manufactured by SPEC International Inc., or approved equal.

F. Water - Water shall be fresh and free from injurious amounts of oil, acid, alkali, salts, or other materials harmful to the growth of grass.

12.3 PROCEDURE:

The Contractor shall adhere to the following procedures in his seeding, application of soil supplements and fertilizing operations. In addition to the Contractor's requirements stated in the Special Requirement entitled "Material Samples Requiring Laboratory Tests", the Department may, upon completion of rough grading, choose to take additional soil samples for testing (at its own expense) to determine if any modifications to the seed and soil requirements are necessary.

A. Preparation of Seed Bed

1. Slopes Flatter Than 3:1 (excluding tops of treatment cell embankments) - After the areas to be seeded have been brought up to grade and approved by the Department, one (1) ton of agricultural limestone, per acre, shall be applied initially over the entire area. This initial amount of limestone application shall be incorporated into the soil to an approximate depth of eight (8) inches by harrowing, plowing or any approved method. After the initial application of the agricultural limestone has been satisfactorily incorporated, the Contractor shall then apply one (1) more ton of agricultural limestone, per acre, in conjunction with the specified amount of commercial fertilizer. The tillage operation shall be sufficient to insure that the condition of the soil is satisfactory for seeding and that the commercial fertilizer and limestone are thoroughly incorporated into the soil to a depth of at least three (3) inches. The area will then be smoothed and brought to grade. Immediately prior to the sowing of seed, the soil shall be scarified to an approximate depth of 3/4 inch. All scarifying shall be done in a direction parallel to the contour lines on the slope and not

uphill or downhill. When commercial fertilizer and the second application of limestone are incorporated with hydroseeding, the surface need not be tilled to a depth of three (3) inches, but the surface shall be scarified to an approximate depth of 3/4 inch prior to seed application.

2. Top of Treatment Cell Embankments and Slopes 3:1 and Steeper - After the areas to be seeded have been brought up to grade and approved by the Department, the slopes shall be scarified in a horizontal direction to sufficiently break up the surface crust for bedding the seed. The total amount of two (2) tons of agricultural limestone, per acre, shall be applied in one (1) application and may be incorporated with fertilizer in the hydroseeding process.

   On all surfaces to be seeded, sticks, rocks, weeds, roots, or other objectionable material appearing on the surface which, in the opinion of the Department will be detrimental to obtaining a satisfactory stand of vegetation, shall be removed. The finished surface of the soil shall be maintained in a true and even condition during the sowing of the seed.

B. Commercial Fertilizer - Commercial fertilizer shall be applied at the following rates per acre:

80 pounds of nitrogen
160 pounds of phosphate
160 pounds of potash

No more than forty (40) pounds of nitrogen, eighty (80) pounds of phosphate and eighty (80) pounds of potash, per acre, shall be placed in the hydroseeder with the seed. The remaining amount of fertilizer required shall be applied separately. Sixty (60) pounds, per acre, of the nitrogen requirement shall be from a slow-release source such as Ureaform.

C. Inoculant - All leguminous seed shall be inoculated or treated with an approved culture as recommended by the supplier. If hydroseeding, use five (5) times the manufacturer's recommended amount of inoculant. If a conventional method of seeding is used, the seed shall then be sown within twenty-four (24) hours after treatment. If hydroseeding is used, the inoculant shall be added just prior to seeding. Inoculant must be kept at temperatures below 75° F.

The inoculant shall be viable and made up of several bacterial strains which are specified for the legume group to be inoculated. Inoculant shall not be used later than the date indicated on the container or specified by the supplier.

D. Method of Sowing - The grass seed mixture shall be sown on a still day at the rate per acre as specified. For conventional seeding applications, the seed shall be

sown either by hand or by approved sowing equipment in two (2) applications, one-half the seed while the seeder is traveling in one direction and the other half while traveling at right angles to the first direction.

Hydroseeding or drilling may be used for seed application at the option of the Contractor. All methods and equipment shall be subject to the approval of the Department. In the case of hydroseeding, commercial fertilizer and limestone (second application, only, on slopes flatter than 3:1) may be applied during the seeding operation. Inoculated seed shall not be held in a slurry with commercial fertilizer for more than one (1) hour. Reinoculation or application of legumes separate from commercial fertilizer will be required where this time limit cannot be done at the same time as the seeding, provided the fertilizer does not come in contact with the seed. Drilling shall be done only parallel to the contour.

E. Mulching - Within forty-eight (48) hours after sowing has been completed, mulch shall be uniformly applied over the entire surface at an average rate of three (3) tons (dry weight) per acre and spread to a uniform depth. The mulch shall be in a moist condition at the time of placement or shall be sprinkled immediately after placing. While moist, the material shall be anchored in the soil by a disc harrow or any other approved method to secure the material firmly in the ground to form a soil-binding mulch and prevent loss or bunching by wind. Mulch material cut into lengths less than six (6) inches will not be acceptable.

As an alternate "tie-down", approved asphaltic emulsion applied at a rate not less than one hundred fifty (150) gallons per acre or non asphaltic emulsion applied at the manufacturer's recommended rate may be used, provided the emulsion is applied uniformly over and through the mulch. A mechanical blower may be used to apply the mulch if it is specifically designed and approved for that purpose.

12.4 MAINTENANCE:

The Contractor shall maintain the areas completed in accordance with the requirements of this section until all work under the contract has been completed and has been accepted by the Department. The maintenance shall consist of refilling rain-washed gullies, with the same or better type of soils that were eroded, reseeding, reapplying soil supplements and mulch, as directed by the Department.

Within the one (1) year remedy guarantee period, as specified in Subsection 5.18 of the General Conditions, the Contractor shall reseed in accordance with these specifications any areas where satisfactory growth has not been obtained, in the opinion of the Department.

12.5 MEASUREMENT:

Measurement will be made of the number of acres, and fractions of an acre, acceptably prepared where called for in this specification and in any other area where the Department

has agreed to make payment. Measurement will also be made of the amount of agricultural limestone (by the ton), amount of commercial fertilizer (by the pound), amount of seed (by the pound) and amount of mulch (by the acre) used on the specified or agreed to areas. No measurement will be made of work done or materials used on areas which are reseeded under the provisions of Section 12.4 of this specification, nor of areas requiring seeding because of the Contractor's operations outside of designated payment areas.

12.6 PAYMENT:

Payment for "Seeding" will be made at the contract unit prices bid per acre for "a) Seed Bed Preparation", per ton for "b) Agricultural Limestone", per pound for "c) Commercial Fertilizer", per pound for "d) Seed - Type 1", per pound for "e) Seed - Type 2", and per acre for "f) Mulching".

The prices bid shall include all costs involved in providing the materials, equipment and personnel required for the particular bid item, and for performing the necessary work. No additional payment will be made for required reseeding of unsatisfactory areas.

If, as a result of soil testing done under the provisions of Section 12.3 of this specification, soil supplement amounts need to be modified from those shown in this specification, all quantities increased of decreased are to be performed at the unit prices bid in the Schedule of Prices.

TECHNICAL SPECIFICATION NO. 13 - WETLAND PLANTING

13.1 SCOPE:

The Contractor shall plant all passive treatment cells containing spent mushroom compost, designated on the Drawings, with root stock plant material. The work covered by this section consists of furnishing and placing root stock material and maintaining planted areas. The time of the planting may be selected by the Contractor who shall be responsible for securing a satisfactory stand of wetland vegetation. Planting should be performed as soon as possible following the completion and approval of the passive treatment systems and final grading around the passive treatment systems.

13.2 MATERIALS:

The Contractor shall furnish all of the plant materials specified. Unless stated otherwise in the following paragraphs, all sampling and testing of these materials will be at the direction of the Department and at the Contractor's expense. All materials shall be furnished by suppliers who are approved by the Department.

A. Wetland Plant Material - Plant material will consist of the following:

Common Name	Botanical Name	Form	Spacing	Plants/acre
Common Cattail	*Typha lattifolia*	Bare Root	3 feet	2300
Soft Rush	*Juncus effusus*	Bare Root	3 feet	2300

The Contractor shall make every effort to obtain sufficient quantities of the selected wetland species. In the event a species cannot be obtained at the time of planting, subject to approval of the Department, the Contractor may add other wetland plant material to the mixture to secure a standing crop, but no additional payment will be made therefor.

All plant material shall conform with regulations of the Department of Agriculture, Bureau of Plant Industry. Certification of purity and viability must be supplied to the Department.

Root stock shall be furnished fully tagged and delivered by separate varieties, separately packaged or bagged. No root stock shall be used unless it has been inspected and sampled under Department supervision.

Plant material which has become moldy, wilted or otherwise damaged in transit or storage will not be accepted.

Root stock shall be planted as soon as reasonably possible to ensure viability and success of planting.

13.3 PROCEDURE:

The Contractor shall adhere to the following procedures in his planting of root stock material.

A. Treatment Cell Preparation - The spent mushroom compost shall be placed according to procedures in Technical Specification No. 9. Water from the AMD discharge shall be directed into the treatment units to obtain water levels within six (6) inches of the surface of the compost layer. The water level shall be maintained prior to and during planting of root stock.

B. Method of Planting - The root stock shall be planted in the compost at the density specified in Section 13.2. The species of root stock planted at each location shall be randomly selecting. The root stock will be hand planted by forming a hole, approximately two (2) inches in diameter and four (4) inches deep, placing an individual plant (root first) into the hole, and compressing the spent mushroom compost around the plant.

C. Post Planting - After planting is complete, the AMD discharge shall be directed into the treatment cells to obtain a water level at the surface of the compost layer. This water level shall be maintained for a period of no less than 14 days. After this 14 day compost stabilization period the AMD discharge shall be directed into the treatment cells to the required water levels, approximately six (6) inches above the compost.

13.4 MAINTENANCE:

The Contractor shall maintain the planted areas for a period of one month following planting by monitoring the plant material. Dislodged plants shall be returned to appropriate locations and/or replaced if damaged.

Within the one (1) year remedy guarantee period, as specified in Subsection 5.18 of the General Conditions, the Contractor shall replant in accordance with these specifications any areas where satisfactory growth has not been obtained, in the opinion of the Department.

13.5 MEASUREMENT:

Measurement will be made of the number of acres, and fractions of acres, acceptably planted with root stock where called for in this specification and in any other area where the Department has agreed to make payment. No measurement will be made of work done or materials used on areas which are replanted under the provisions of Section 13.4 of this specification, nor of the areas requiring planting because of the Contractor's operations outside of designated payment areas.

13.6 PAYMENT:

Payment for "Wetland Planting" will be made at the contract unit prices bid per acre for "Site 1" and for "Site 2", which prices shall include full compensation for all labor, equipment, materials and incidentals required to perform the work described and as shown on the Drawings No additional payment will be made for required replanting of unsatisfactory areas.

TECHNICAL SPECIFICATION NO. 14 - IMPLEMENTAION OF EROSION AND SEDIMENT CONTROL PLAN

14.1 SCOPE:

Work covered by this specification consists of furnishing all labor, equipment, and materials necessary for implementation of Erosion and Sediment Control measures as described below and specified on the Drawings. The work in this section shall be conducted in complete compliance with the requirements of the plan outlined on the

Drawings, and rules and regulations of the Department and the Bradford County Conservation District.

Control measures specified herein and indicated on the Drawings are the minimum considered necessary to achieve acceptable erosion and sediment management. Additional controls may be required at problem areas that develop during construction.

To maximize the effectiveness of the plan, the Contractor shall arrange an on-site review with personnel of the Bradford County Conservation District to determine how to best implement the plan. In addition to the information herein and on the Drawings, construction and installation details for erosion and sedimentation control measures are contained in the Soil Erosion and Sediment Pollution Control Handbook for Bradford County.

Fines and related costs resulting from the Contractor's failure to provide adequate protection against soil erosion shall be borne by the Contractor.

14.2 MATERIALS:

The Contractor shall furnish all of the material specified. Unless stated otherwise in the following paragraphs, all sampling and testing of these materials will be at the direction of the Department and at the Contractor's expense. All material shall be furnished by suppliers who are approved by the Department.

A. Earth Fill - On site soil or soil-rock mixed materials free of topsoil, plant life, lumber, metal, refuse and rock or similar hard objects larger than six inches in greatest dimension.

B. Clean Earth Fill - On site material free of plant life, lumber, metal, refuse and rocks or similar hard objects larger than one inch in greatest dimension.

C. Aggregates - Coarse Aggregate shall conform to PennDOT Publication 408 Section 703.2.

D. Geotextiles - Geotextile shall conform to PennDOT Publication 408, Section 735.
    1. Silt Fence/Filter Barrier: Class 3, Type A or B.
    2. Rock Filters: Class 3, Type A.
    3. Stabilized Construction Entrance: Class 4.
    4. Rock-lined Channels: Class 2, Type A.

E. Stakes - Sound, rough-sawn Cedar or hardwood measuring two by two inches, length as required, with tapered point, or equivalent steel stakes.

F. Reinforcement Bars - Conforming to ASTM A 615 (S1), Grade 60, Deformed.

G. Wire - Conforming to ASTM A 82.

H. Staples - For anchoring soil stabilizing materials provide staples of No. 11 gauge wire or heavier. Their length shall range from six to ten inches, with the longer staples used on loose, unstable soils.

I. Wire Reinforcement for Silt Fences - A maximum of 42 inches in height, a minimum of No. 14 gauge and having a maximum mesh spacing of six inches.

J. Riprap - Field stone or rough unhewn quarry stone of approximately rectangular shapes. Provide stones of such quality that will not disintegrate on exposure to water or weathering and meeting the requirements for R-3 and R-4 specified in PennDOT Publication 408, Section 850, and for R-2 in the Department's Erosion and Sediment Pollution Control Program Manual.

K. Mulching Materials - Conforming to requirements of Section 12.2.E of these specifications.

L. Temporary Vegetative Cover - Temporary seed shall be Formula E in accordance with PennDOT Publication 408, Section 804.2.

M. Straw Bales - Straw stalks of threshed grain or tall hay grass stalks, either wire-bound or nylon twine-bound, and commercially available locally.

14.3 PROCEDURE:

A. General Requirements - Remove material not replaced in the excavations and dispose of promptly and in a manner that minimizes erosion. Protect stockpiled material with such measures as indicated in Section B and on the Drawings. Where the material is spread, provide stabilization as indicated in Section C.

B. Stockpiled Material Areas -

1. Topsoil temporarily excavated is to be placed in the approved topsoil stockpile areas identified on the Drawings.
2. Adequately protect materials against erosion when deposited in such stockpile area. Protection may be in the following manner:
    a. Provide temporary vegetative cover, Section 14.3.I, by seeding and mulching the area immediately upon placement of stored materials.
    b. Protect the down slope sides of stockpiled materials with a haybale or silt fence barrier as indicated on the Drawings.

C. Excess Material and Spoil Areas -

1. Excess excavated materials not incorporated into the site are to be disposed in the approved disposal area identified on the Drawings. Grade excess excavated material areas to a slope of 20 percent or less.

2. Adequately protect materials against erosion when deposited in such spoil area by seeding and mulching the area according to Technical Specification No. 12, "Seeding", immediately upon completion of grading.
3. Protect the down slope sides of spoil area with a haybale or silt fence barrier until vegetative cover has become established.
4. Do not place excess material within the limits of any existing drainageways.

D. Sediment Removal Pond - Use for sediment removal from pumped water at the location shown on the Drawings or at locations designated by the Department.
   1. Pond area shall be cleared, grubbed and stripped of vegetation and root mat.
   2. Use Rock Filter for the discharge embankment.
   3. Side embankments may be created by excavation or by construction of rock embankments as shown on the Drawings.
   4. Sediment shall be removed and the pond restored to its original dimensions when the sediment has accumulated to 35 percent the design depth of the pond. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
   5. The structure shall be inspected after each rain and repairs made as needed.
   6. Construction operations shall be carried out in such a manner that erosion and water pollution is minimized.
   7. The structure shall be removed when pumping is no longer required.

E. Stabilized Construction Entrance - Use at points of construction ingress and egress and construct as indicated on Drawings.
   1. Washing - When necessary, clean vehicle wheels to remove sediment prior to entrance onto public right-of-way. When washing is required, use an area stabilized with crushed stone which drains into an approved sediment trap or sediment basin. Prevent sediment from entering storm drains, ditches, or watercourse through use of sand bags, gravel, boards or additional approved methods.
   2. Install geotextile material in accordance with the requirements of PennDOT Publication 408, Section 212.
   3. Maintenance - Maintain the entrance in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This will require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. Sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

F. Temporary Sediment Barrier -
   1. Silt Fence: Constructed of standard strength or extra strength synthetic filter fabrics and designed for situations in which only sheet or overland flows are expected.

  - a. Height shall not exceed 30 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).
  - b. Provide filter fabric in a continuous roll cut to the length of barrier to avoid the use of joints. When joints are necessary, splice filter cloth together only at a support stake, with a minimum six inch overlap, and securely sealed.
  - c. Space stakes a maximum of eight feet apart in the barrier and drive securely into the ground minimum of 12 inches. When extra strength fabric is used without the wire support fence, stake spacing shall not exceed five feet.
  - d. Staple standard strength filter fabric to the wooden stakes and extend twelve inches of the fabric into a 6 x 6-inch trench and backfill over the fabric. The fabric shall not extend more than 30 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.
  - e. When standard strength filter fabric is used, provide a wire mesh support fence fastened securely to the upslope side of the stakes using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of six inches and shall not extend more than 30 inches above the original ground surface.
  - f. When extra strength filter fabric and closer stake spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the stakes.
  - g. Remove silt fences when no longer necessary, but not before the upslope area has been permanently stabilized.

G. Rock Filter - Construct rock filter according to the following:
  1. Place rock, according to the Schedule in the Drawings, in the rock filter to produce an even distribution of rock pieces, with minimum voids. Place the geotextile in accordance with the Drawings and PennDOT Publication 408, Section 212.
  2. Maintenance - Remove filter when clogged with sediments. Filter materials shall be washed completely free of sediment, or new rock used to rebuild the filter.

H. Seeding and Mulching -
  1. Temporary Vegetative Cover -
    - a. Sow grass at the rate of 10 pounds per 1,000 square yard by broadcasting, drilling, or hydraulic application; plus a straw mulch anchored to prevent loss.
    - b. Cover grass seeds with 1/4 inch of soil using suitable equipment for that purpose.
  2. Permanent Vegetative Cover - As indicated in Technical Specification No. 12, "Seeding".

I. Maintenance -

1. In general, check all erosion and sediment control measures weekly and after each significant rainfall.
2. Excavate, spread and dry sediment for use in on-site grading.
3. Remove unsuitable material from the site for proper disposal.
4. Clean sediment traps when sediment accumulates to 35 percent of the design depth of the trap.
5. Check seeded areas regularly to see that a good vegetation stand is maintained. Fertilize and reseed areas as needed.
6. Frequently check and closely monitor mulched areas with respect to their effectiveness in controlling erosive storm runoff velocities and sediment transport. Re-mulch areas as often as necessary until adequate ground cover is established.
7. Temporary Sediment Barrier -
    - a. Inspect Silt Fences and Filter Barriers immediately after each rainfall and at least daily during prolonged rainfall. Make required repairs immediately.
    - b. Should the fabric decompose or become ineffective prior to the end of the expected usable life, replace the fabric promptly.
    - c. Remove sediment deposits after each storm event and when deposits reach approximately one-half the height of the barrier.
    - d. Grade sediment deposits remaining in place after the silt fence or filter barrier is no longer required, to conform with the existing grade.
    - e. Regrade temporary controls and channels after they are no longer needed and seed in accordance with Technical Specification No. 4, "Grading" and No. 12, "Seeding".

J. Removal -

1. Temporary erosion and sedimentation control measures/facilities shall be removed when all permanent control measures/facilities have been completed and are operational and the site has been stabilized.
2. Areas disturbed by removal of temporary control measures/facilities must be graded to blend into existing contours, have soil supplements applied, seeded, mulched, and stabilized.

14.4 NPDES INDIVIDUAL PERMIT NOTICE OF TERMINATION (NOT):

Upon completion of construction and stabilization of the two sites, both as determined by the Department's Project Engineer, the Contractor shall complete and file for ER-LWC-38, "NOTICE OF TERMINATION (NOT) OF COVERAGE UNDER THE PENNSYLVANIA INDIVIDUAL NPDES PERMIT FOR DISCHARGES OF STORM WATER FROM CONSTRUCTION ACTIVITIES," which is included in the attached Exhibit "B."

The NOT form shall be sent, certified mail with return receipt requested, to the Reviewing Entity for the permit which is the following:

Department of Environmental Protection
Northcentral Regional Office
208 West Third Street, Suite 101
Williamsport, PA 17701-6448

14.5 MEASUREMENT:

Implementation of the erosion and sediment control plan at each site will be considered and measured as a job.

14.6 PAYMENT:

"Implementation of Erosion and Sediment Control Plan" shall include full compensation for the work described and will be paid according to the following schedule:

> Thirty percent (30%) of the lump sum price bid for this item will be paid following complete installation of all Erosion and Sediment Control Facilities;
>
> Ten percent (10%) of the lump sum price bid for this item will be paid for maintenance over the life of the Contract;
>
> Sixty percent (60%) of the lump sum price bid for this item will be paid following stabilization of the site and receipt of the NOT form by the reviewing entity.

This item "Implementation of Erosion and Sediment Control Plan" will be paid for according to the preceding schedule, and payment shall constitute full compensation for furnishing all plant, labor, equipment, materials and supplies required to satisfactorily complete the work described. The cost of temporary seeding will be considered incidental to this item and no separate payment will be made.

DEPA

BRADIA
CONT

PREPARED BY

FLEMING, INC.
O. BOX 67100

PROVED

. VICTOR JR., P.E. CONTRACTING OFFICER DATE

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

ACID MINE DRAINAGE ABATEMENT PROJECT

FALLS CREEK

FRANKLIN TOWNSHIP
BRADFORD COUNTY, PENNSYLVANIA
CONTRACT NO. AMD 08(3295)101.1

DRAWING INDEX

TITLE	DWG NO.
TITLE SHEET	1 of 9
LOCATION, VICINITY, AND INDEX MAPS	2 of 9
PLAN	3 of 9
PLAN	4 of 9
SECTIONS, SCHEDULE AND SCHEMATICS	5 of 9
MISCELLANEOUS DETAILS	6 of 9
MISCELLANEOUS DETAILS AND SCHEDULES	7 of 9
EROSION & SEDIMENT CONTROL - NARRATIVE	8 of 9
EROSION & SEDIMENT CONTROL - DETAILS	9 of 9

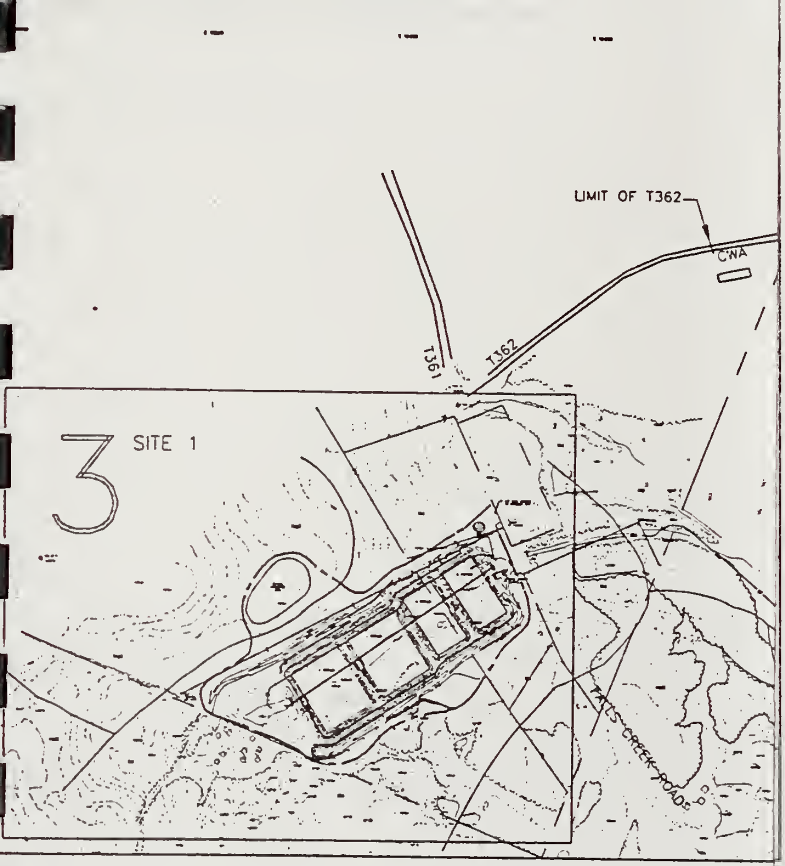
TOM RIDGE
GOVERNOR

JAMES M. SEIF

EPARED BY
FLEMING, INC.
BOX 67100
ISBURG, PA

APPROVED

A.H. VICTOR JR., P.E. CONTRACTING OFFICER DATE



GENERAL NOTES

ISTING TOPOGRAPHY AND ELEVATION DATA BASED ON COMPUTER-BASED MAPPING
ROVIDED BY THE EADS GROUP JOB NO. 11594123.11.

LEVATIONS OF THE FEATURES ARE TO BE TAKEN FROM THE CONTROL POINT DATA THIS SHEET.

L EXISTING UTILITIES SHOWN ON THE PLANS ARE BASED ON THE BEST AVAILABLE
FORMATION. THE ENGINEER DOES NOT CERTIFY THE CORRECTNESS OR COMPLETENESS
THE EXISTING UTILITY PORTRAYAL. THE CONTRACTOR SHALL CONTACT ALL UTILITY
MPANIES PRIOR TO INITIATION OF CONSTRUCTION AND SHALL BE RESPONSIBLE FOR
ORDINATING HIS ACTIVITIES WITH THE UTILITY COMPANIES.

NTOUR INTERVAL IS 2 FEET.

L DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE
NTRACTOR AT THE SITE.

L PROPERTY BOUNDARIES SHOWN ON THE PLANS ARE BASED ON THE BEST AVAILABLE
FORMATION. THE ENGINEER DOES NOT CERTIFY THE CORRECTNESS OR COMPLETENESS
THE PROPERTY BOUNDARIES.

NOR ADJUSTMENT IN GRADE MAY BE MADE BY THE ENGINEER TO SUIT THE FIELD
NDITIONS.

MITS OF GRADING AND SEEDING SHOWN ON THE PLAN ARE APPROXIMATE. MINOR
VIATIONS MAY BE PERMITTED SUBJECT TO THE APPROVAL OF THE ENGINEER.

L AREAS DISTURBED OUTSIDE THE GRADING AND SEEDING LIMITS MUST BE RESTORED
AT LEAST AS GOOD AS THE EXISTING CONDITIONS.

TT FLEMING, INC. ADVISES THAT IT HAS COMPLIED WITH THE PROVISIONS OF THE UNDER-
UTILITY LINE PROTECTION LAW, AS AMENDED, IN PREPARING THESE DRAWINGS REQUIRING
ON OR DEMOLITION WORK AT SITES WITHIN THE COMMONWEALTH OF PENNSYLVANIA.
TT FLEMING, INC. DOES NOT MAKE ANY REPRESENTATION, WARRANTY, ASSURANCE OR
Y THAT THE INFORMATION RECEIVED PURSUANT TO SAID ACT AND REFLECTED ON THESE
S IS CORRECT OR ACCURATE, BUT GANNETT FLEMING, INC. IS REFLECTING SAID INFORMATION
DRAWINGS IN ACCORDANCE WITH THE REQUIREMENTS OF ACT 287 OF 1974 AS AMENDED.

NTRACTOR SHALL COMPLY WITH ACT 287 OF THE GENERAL ASSEMBLY, AS AMENDED,
DEFINES THE PROCEDURES FOR NOTIFICATION TO PUBLIC UTILITIES PRIOR TO EXCAVATION,
G OR DEMOLITION WORK USING POWER EQUIPMENT OR EXPLOSIVES.

UTILITY LIST

CLAVERACK RURAL ELECTRIC COOPERATIVE
RR 2, BOX 17
WYSOX, PA 18854
(717) 265-2167

COMMONWEALTH TELEPHONE COMPANY
17 MAIN STREET
TOWANDA, PA 18848
(717) 265-5111

CANTON TELEPHONE COMPANY
4 NORTH CENTER STREET
CANTON, PA 17724
(717) 673.5101

PA. ELECTRIC COMPANY
PLAZA DRIVE, CALL BOX 506
TOWANDA, PA 18848
1-800-242-1776

ABBREVIATIONS

AMD	ACID MINE DRAINAGE
PVC	POLYVINYL CHLORIDE
D.I.	DUCTILE IRON
LLDPE	LINEAR LOW DENSITY POLYETHYLENE GEOMEMBRANE
DIA.	DIAMETER
EXIST.	EXISTING
DWG.	DRAWING

SOILS INFORMATION

MsB - MORRIS VERY STONY SILT LOAM, 3 TO 8 PERCENT SLOPES
WgB - WELLSBORO VERY STONY SILT LOAM, 3 TO 8 PERCENT SLOPES
WgD - WELLSBORO VERY STONY SILT LOAM, 8 TO 25 PERCENT SLOPES
Ud - UDORTHENTS, VERY CHANNERY

NO.	DATE	REVISION	APPR.

SUBMITTED
William J. Smyers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SMYERS

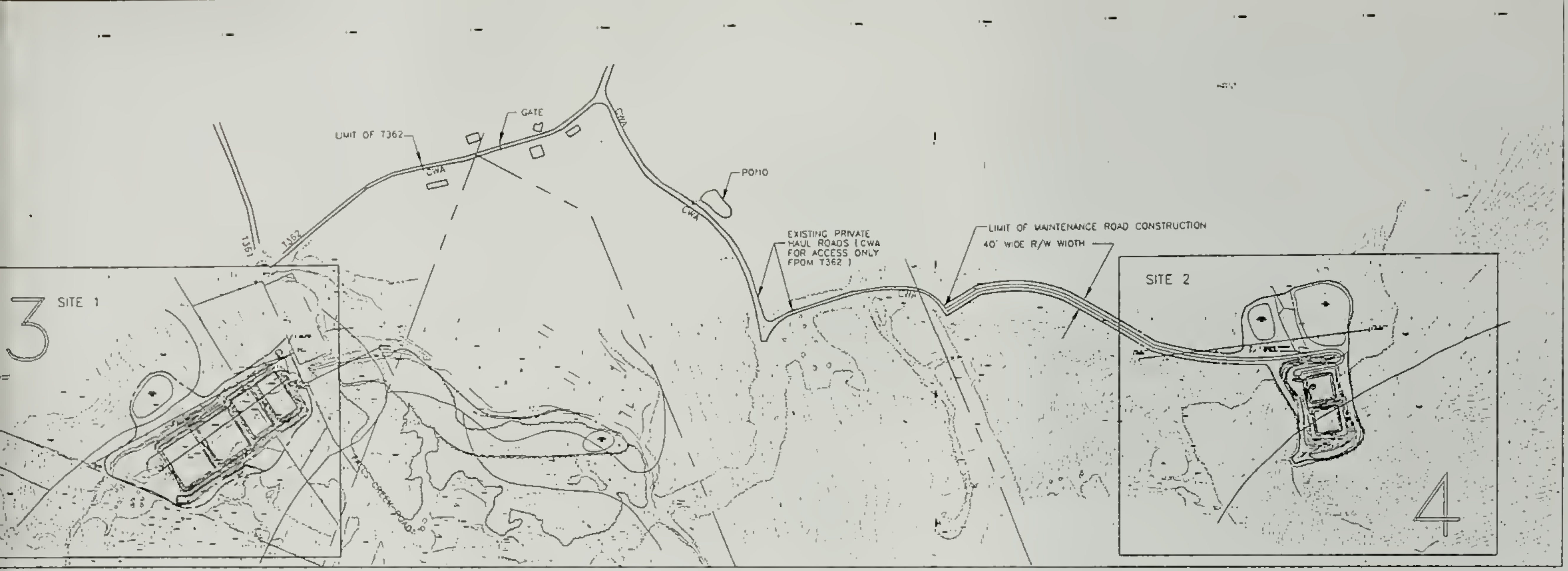
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK
FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

INDEX, VICINITY &
LOCATION MAPS



LIMIT OF T362
GATE
POND
CWA
T362
T361
EXISTING PRIVATE HAUL ROADS (CWA FOR ACCESS ONLY FROM T362)
LIMIT OF MAINTENANCE ROAD CONSTRUCTION
40' WIDE R/W WIDTH
SITE 1
SITE 2
3
4

INDEX MAP

SCALE 1"= 250'

UTILITY LIST

CLAVERACK RURAL ELECTRIC COOPERATIVE
RR 2, BOX 17
WYSOX, PA 18854
(717) 265-2167

COMMONWEALTH TELEPHONE COMPANY
17 MAIN STREET
TOWANDA, PA 18848
(717) 265-5111

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4 NORTH CENTER STREET
CANTON, PA 17724
(717) 673.5101

PA. ELECTRIC COMPANY
PLAZA DRIVE, CALL BOX 506
TOWANDA, PA 18848
1-800-242-1276

ABBREVIATIONS

AMD	ACID MINE DRAINAGE
PVC	POLYVINYL CHLORIDE
D.I.	DUCTILE IRON
LLDPE	LINEAR LOW DENSITY POLYETHYLENE GEOMEMBRANE
DIA.	DIAMETER
EXIST.	EXISTING
DWG.	DRAWING

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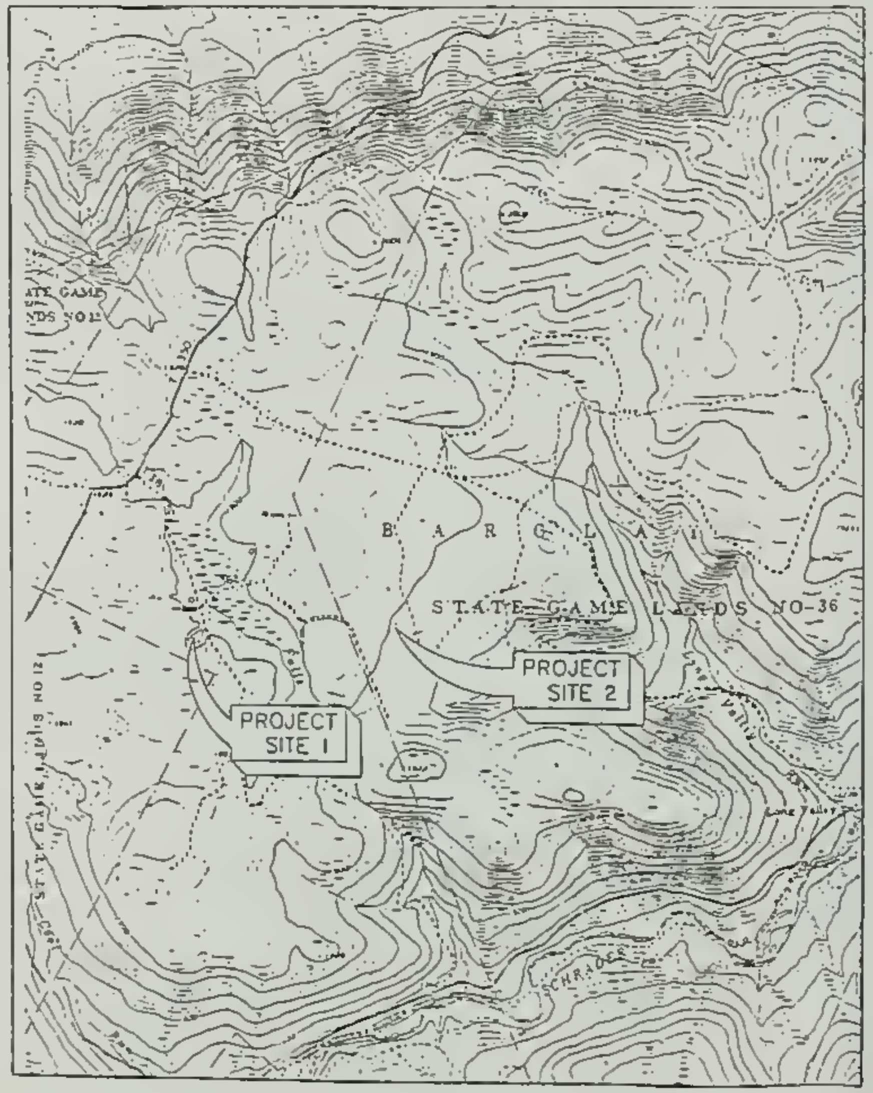
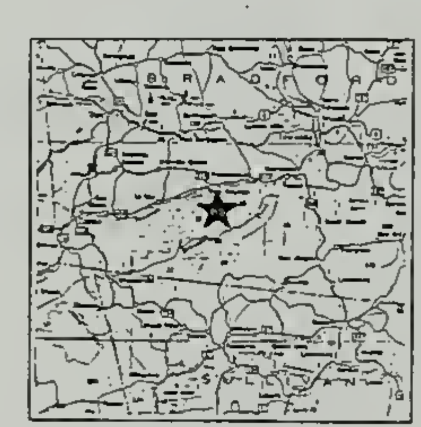


VICINITY MAP

SCALE 1"=2000'



LOCATION MAP

SCALE 1"=7.3 MILES

SOILS INFORMATION

MsB - MORRIS VERY STONY SILT LOAM, 3 TO 8 PERCENT SLOPES
WgB - WELLSBORO VERY STONY SILT LOAM, 3 TO 8 PERCENT SLOPES
WgD - WELLSBORO VERY STONY SILT LOAM, 8 TO 25 PERCENT SLOPES
Ud - UDORTHENTS, VERY CHANNERY

CONTROL POINT DATA

NUMBER	COORDINATES		ELEV. (FT)	DESCRIPTION
	NORTHING	EASTING		
DER-1	10744.91	18424.48	1933.33	REBAR SET, LEAD CAP
DER-2	11175.77	19237.39	1908.37	REBAR SET, LEAD CAP

NO.	DATE	REVISION	APPR.

SUBMITTED
William J. Smites 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR, BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SMITES

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

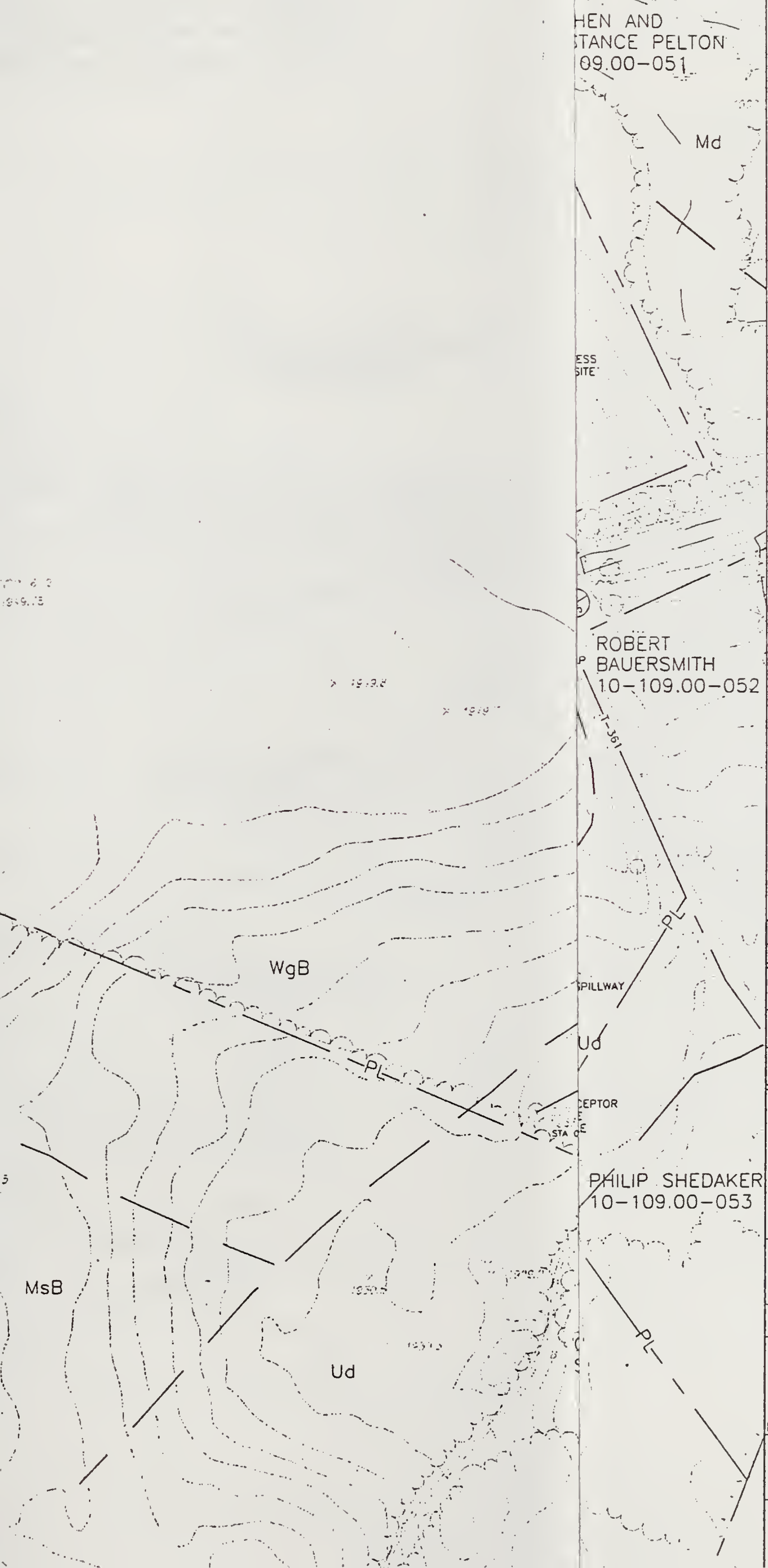
ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK
FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

INDEX, VICINITY &

RIOR CELL GRADES REPRESENT CELL SUBGRADE ELEVATIONS.

SUMMARY TABLE ON DRAWING No. 7 FOR TREATMENT MEDIA DEPTHS.



N

LEGEND

1930	EXISTING TEN FOOT CONTOUR
	EXISTING TWO FOOT CONTOUR
	EXISTING EDGE OF ROAD
—PL—	PROPERTY LINE
1930	PROPOSED 10 FOOT CONTOUR
	PROPOSED 2 FOOT CONTOUR
— — — —	EDGE OF WATER/STREAM
	EXISTING SPOT ELEVATION
x 1930	PROPOSED SPOT ELEVATION
A / XX	DETAIL DESIGNATION SHEET WHERE DETAIL APPEARS
S1 / XX	CROSS SECTION DESIGNATION SHEET No. WHERE SECTION APPEARS
— — CWA — —	LIMITS OF CONTRACTOR'S WORK AREA
	EXISTING TREE LINE
	PROPOSED TREE LINE
	EXISTING UTILITY POLE
	EXISTING CONTROL POINT AND ELEVATION
SF	SILT FENCE
RFO	ROCK FILTER OUTLET
— — —	SOILS BOUNDARY
MgD	SOILS DESIGNATION
P	PUMP INTAKE AND DISCHARGE LINES

50 0 50 100
SCALE IN FEET

NO.	DATE	REVISION	APPR.

SUBMITTED
William C [illegible] 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL

WILLIAM JAMES SAYERS

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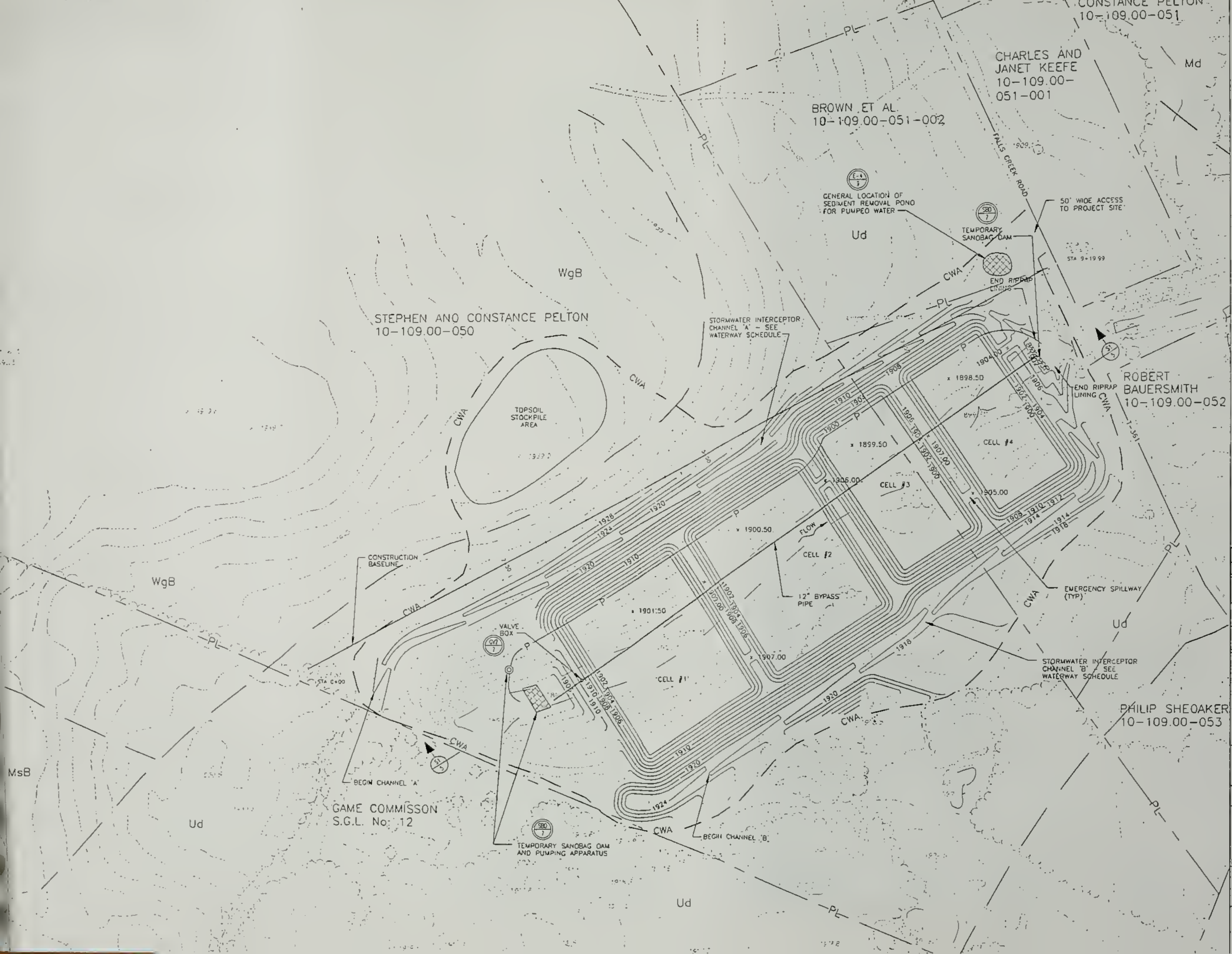
FALLS CREEK

FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

PLAN-SITE 1

CELL GRADES REPRESENT CELL SUBGRADE ELEVATIONS
MMARY TABLE ON DRAWING No. 7 FOR TREATMENT MEDIA DEPTHS.



LEGEND

- - - 1930 - - -	EXISTING TEN FOOT CONTOUR
- - - - -	EXISTING TWO FOOT CONTOUR
- - - - - -	EXISTING EDGE OF ROAD
—— PL ——	PROPERTY LINE
—— 1930 ——	PROPOSED 10 FOOT CONTOUR
————	PROPOSED 2 FOOT CONTOUR
— — —	EDGE OF WATER/STREAM
	EXISTING SPOT ELEVATION
x 1930	PROPOSED SPOT ELEVATION
A / XX	DETAIL DESIGNATION SHEET WHERE DETAIL APPEARS
S1 / XX	CROSS SECTION DESIGNATION SHEET No. WHERE SECTION APPEARS
— — CWA — —	LIMITS OF CONTRACTOR'S WORK AREA
	EXISTING TREE LINE
	PROPOSED TREE LINE
○	EXISTING UTILITY POLE
	EXISTING CONTROL POINT AND ELEVATION
—— SF ——	SILT FENCE
(RFO)	ROCK FILTER OUTLET
—— — ——	SOILS BOUNDARY
MgD	SOILS DESIGNATION
—o—— P ——	PUMP INTAKE AND DISCHARGE LINES

50 0 50 100
SCALE IN FEET

NO.	DATE	REVISION	APPR

SUBMITTED
William J Sayers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SAYERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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FALLS CREEK

FRANKLIN TWP BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

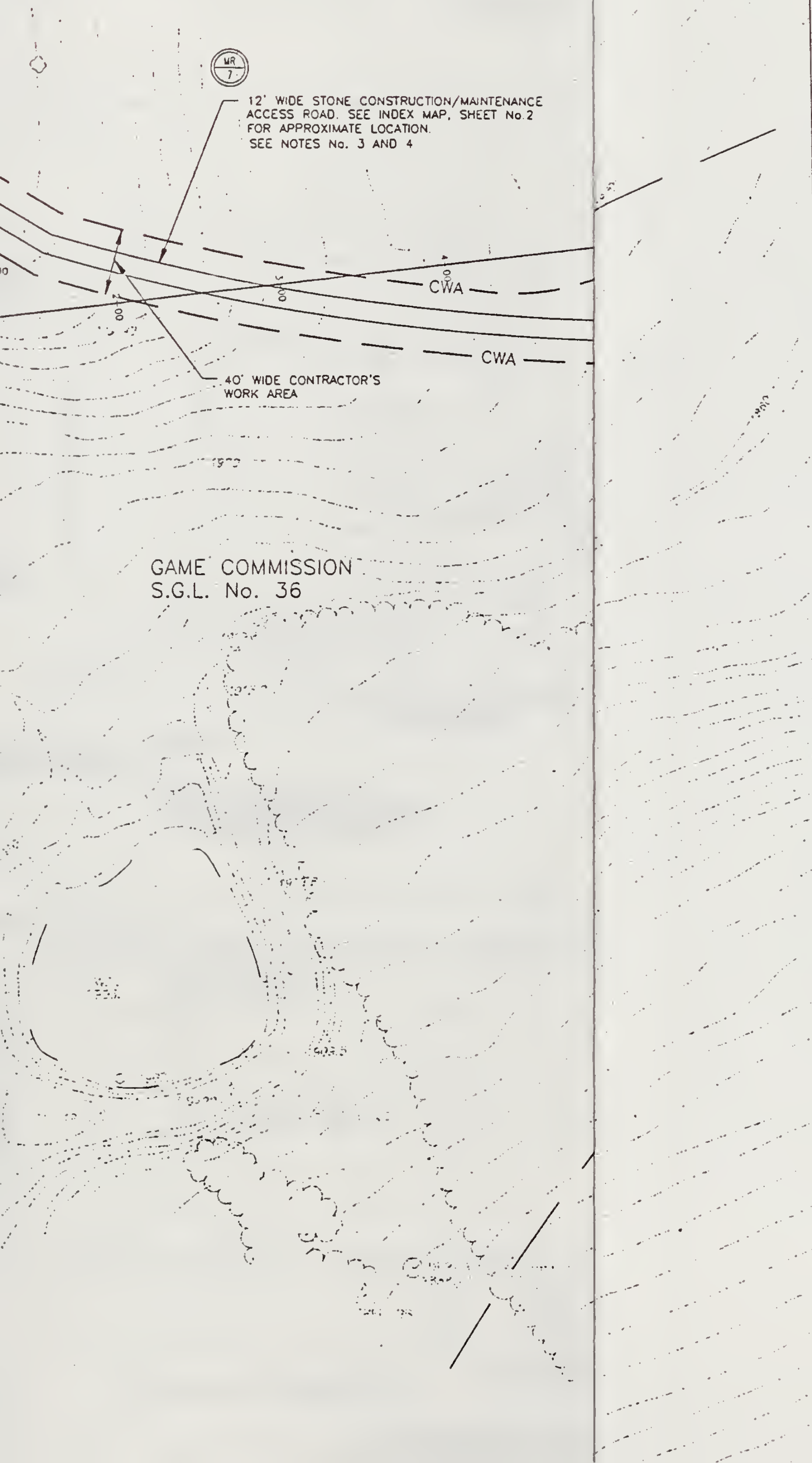
PLAN–SITE 1

L GRADES REPRESENT CELL SUBGRADE ELEVATIONS.

Y TABLE ON DRAWING No. 7 FOR TREATMENT MEDIA DEPTHS.

ADING NOT SHOWN. CONSTRUCT ROADWAY ACCORDING TO
PECIFICATION No. 7.

TO PROVIDE 2 FT. (MIN.) OF COVER OVER THE TWIN 18"
H DENSITY POLYETHLYENE PIPE.



12' WIDE STONE CONSTRUCTION/MAINTENANCE ACCESS ROAD. SEE INDEX MAP, SHEET No.2 FOR APPROXIMATE LOCATION. SEE NOTES No. 3 AND 4

40' WIDE CONTRACTOR'S WORK AREA

LEGEND

	EXISTING TEN FOOT CONTOUR
	EXISTING TWO FOOT CONTOUR
	EXISTING EDGE OF ROAD
—PL—	PROPERTY LINE
1930	PROPOSED 10 FOOT CONTOUR
	PROPOSED 2 FOOT CONTOUR
	EDGE OF WATER/STREAM
	EXISTING SPOT ELEVATION
x 1930	PROPOSED SPOT ELEVATION
A XX	DETAIL DESIGNATION SHEET WHERE DETAIL APPEARS
S1 XX	CROSS SECTION DESIGNATION SHEET No. WHERE SECTION APPEARS
CWA	LIMITS OF CONTRACTOR'S WORK AREA
	EXISTING TREE LINE
	PROPOSED TREE LINE
	EXISTING UTILITY POLE
	EXISTING CONTROL POINT AND ELEVATION
SF	SILT FENCE
RFO	ROCK FILTER OUTLET
	SOILS BOUNDARY
MgD	SOILS DESIGNATION
P	PUMP INTAKE AND DISCHARGE LINES

50 0 50 100
SCALE IN FEET

NO.	DATE	REVISION	APPR.

SUBMITTED
William J. Sayers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
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GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

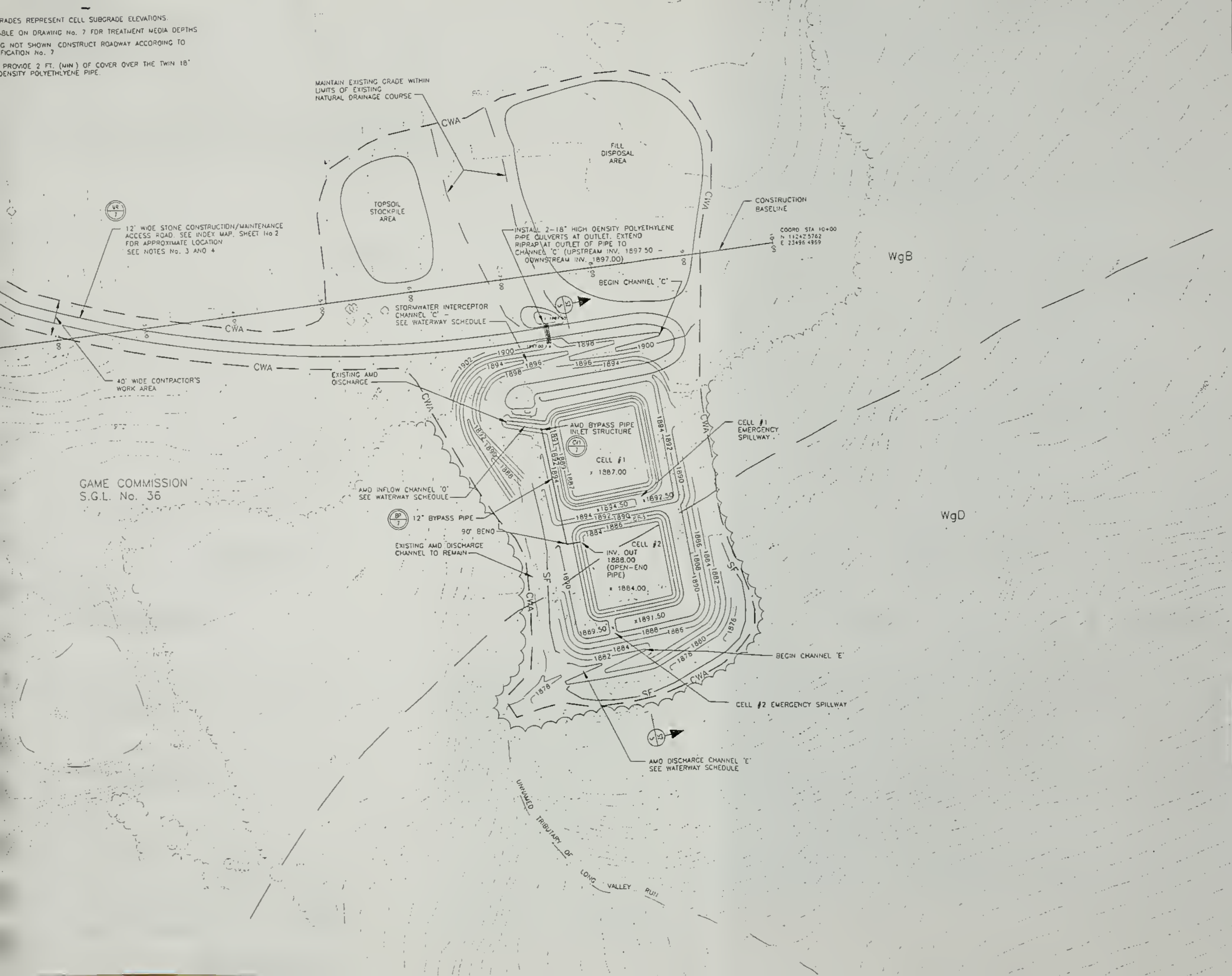
PLAN-SITE 2

RADES REPRESENT CELL SUBGRADE ELEVATIONS.

BLE ON DRAWING No. 7 FOR TREATMENT MEDIA DEPTHS

G NOT SHOWN CONSTRUCT ROADWAY ACCORDING TO
FICATION No. 7

PROVIDE 2 FT. (MIN) OF COVER OVER THE TWIN 18"
DENSITY POLYETHLYENE PIPE.


MAINTAIN EXISTING GRADE WITHIN LIMITS OF EXISTING NATURAL DRAINAGE COURSE
CWA
FILL DISPOSAL AREA
TOPSOIL STOCKPILE AREA
CONSTRUCTION BASELINE
COORD STA 10+00
N 112425762
E 23496 4959
INSTALL 2-18" HIGH DENSITY POLYETHYLENE PIPE CULVERTS AT OUTLET. EXTEND RIPRAP AT OUTLET OF PIPE TO CHANNEL 'C' (UPSTREAM INV. 1897.50 - DOWNSTREAM INV. 1897.00)
BEGIN CHANNEL 'C'
12' WIDE STONE CONSTRUCTION/MAINTENANCE ACCESS ROAD. SEE INDEX MAP, SHEET No 2 FOR APPROXIMATE LOCATION SEE NOTES No. 3 AND 4
STORMWATER INTERCEPTOR CHANNEL 'C' - SEE WATERWAY SCHEDULE
40' WIDE CONTRACTOR'S WORK AREA
EXISTING AMD DISCHARGE
1902
1900
1898
1896
1894
WgB
WgD
GAME COMMISSION S.G.L. No. 36
AMD BYPASS PIPE INLET STRUCTURE
CELL #1
x 1887.00
CELL #1 EMERGENCY SPILLWAY
AMD INFLOW CHANNEL 'D' SEE WATERWAY SCHEDULE
12" BYPASS PIPE
90° BEND
EXISTING AMD DISCHARGE CHANNEL TO REMAIN
x1894.50
x1892.50
CELL #2
INV. OUT 1888.00 (OPEN-END PIPE)
x 1884.00
x1891.50
1889.50
1892
1890
1888
1886
1884
1882
1880
1878
1876
SF
BEGIN CHANNEL 'E'
CELL #2 EMERGENCY SPILLWAY
AMD DISCHARGE CHANNEL 'E' SEE WATERWAY SCHEDULE
UNNAMED TRIBUTARY OF LONG VALLEY RUN

LEGEND

	EXISTING TEN FOOT CONTOUR
	EXISTING TWO FOOT CONTOUR
	EXISTING EDGE OF ROAD
—PL—	PROPERTY LINE
— 1930 —	PROPOSED 10 FOOT CONTOUR
	PROPOSED 2 FOOT CONTOUR
	EDGE OF WATER/STREAM
	EXISTING SPOT ELEVATION
x 1930	PROPOSED SPOT ELEVATION
A/XX	DETAIL DESIGNATION SHEET WHERE DETAIL APPEARS
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— CWA —	LIMITS OF CONTRACTOR'S WORK AREA
	EXISTING TREE LINE
	PROPOSED TREE LINE
	EXISTING UTILITY POLE
	EXISTING CONTROL POINT AND ELEVATION
— SF —	SILT FENCE
RFO	ROCK FILTER OUTLET
	SOILS BOUNDARY
MgD	SOILS DESIGNATION
— P —	PUMP INTAKE AND DISCHARGE LINES

50 0 50 100
SCALE IN FEET

NO.	DATE	REVISION	APPR

SUBMITTED
7/23/96
PROFESSIONAL

APPROVED

DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL

[illegible]

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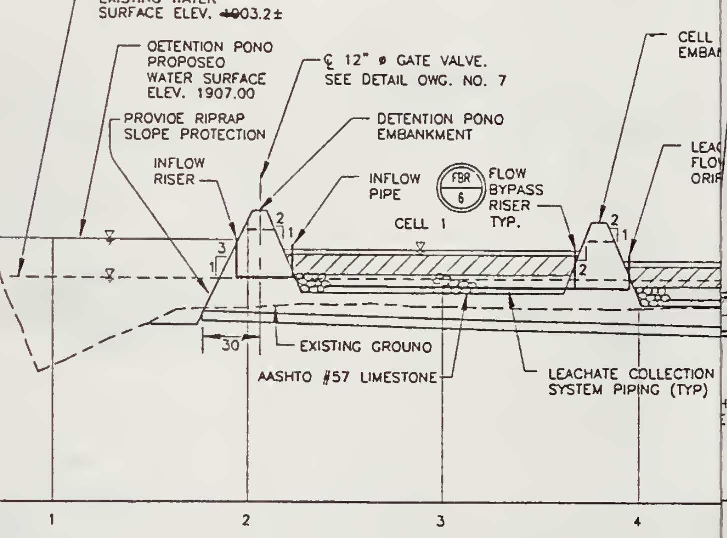
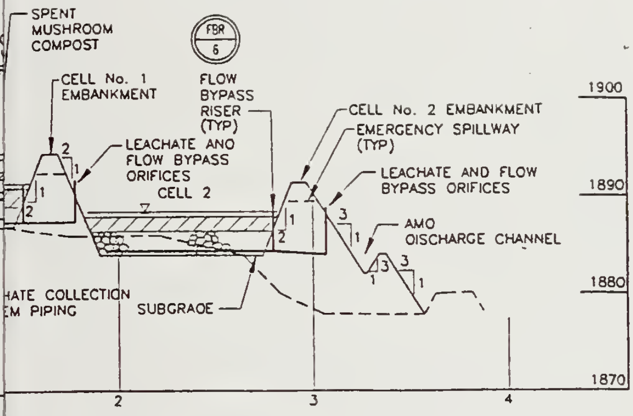
P.O. BOX 67100 HARRISBURG, PA

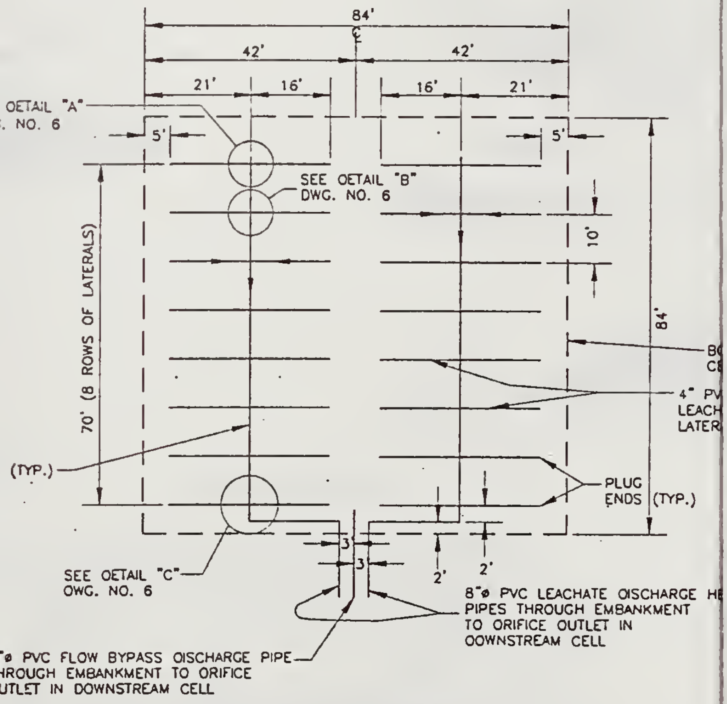
PLAN-SITE 2


EXISTING WATER SURFACE ELEV. 1903.2±
DETENTION POND PROPOSED WATER SURFACE ELEV. 1907.00
℄ 12" ø GATE VALVE. SEE DETAIL DWG. NO. 7
PROVIDE RIPRAP SLOPE PROTECTION
DETENTION POND EMBANKMENT
INFLOW RISER
INFLOW PIPE
FBR 6
FLOW BYPASS RISER TYP.
CELL 1
CELL EMBA
LEAC FLO ORIF
30'
EXISTING GROUND
AASHTO #57 LIMESTONE
LEACHATE COLLECTION SYSTEM PIPING (TYP)
1
2
3
4

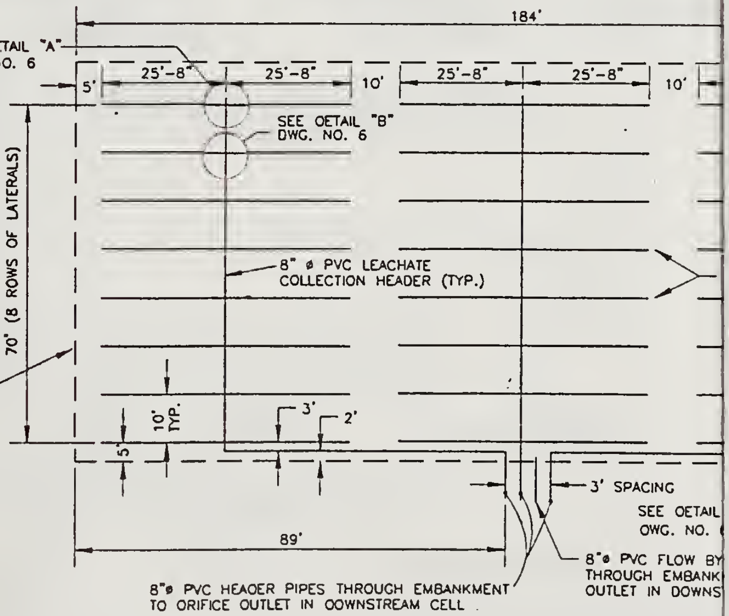


SECTION S2

SCALE: HORZ. 1"=50'
VERT. 1"=10'


84'
℄
42'
42'
21'
16'
16'
21'
DETAIL "A"
. NO. 6
5'
5'
SEE DETAIL "B" DWG. NO. 6
10'
84'
70' (8 ROWS OF LATERALS)
BO
CE
4" PV LEACH LATER
(TYP.)
PLUG ENDS (TYP.)
3'
3'
2'
2'
SEE DETAIL "C" DWG. NO. 6
8"ø PVC LEACHATE DISCHARGE HE PIPES THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL
"ø PVC FLOW BYPASS DISCHARGE PIPE HROUGH EMBANKMENT TO ORIFICE UTLET IN DOWNSTREAM CELL

SITE 2 CELLS #1 & #2
LEACHATE COLLECTION SYSTEM
TYPICAL CELL SCHEMATIC
1"=20'


184'
TAIL "A"
O. 6
5'
25'-8"
25'-8"
10'
25'-8"
25'-8"
10'
SEE DETAIL "B" DWG. NO. 6
70' (8 ROWS OF LATERALS)
8" ø PVC LEACHATE COLLECTION HEADER (TYP.)
10' TYP.
5'
3'
2'
3' SPACING
SEE DETAIL DWG. NO.
89'
8"ø PVC HEADER PIPES THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL
8"ø PVC FLOW BY THROUGH EMBANK OUTLET IN DOWNS

SITE 1 CELLS #3 & #4
LEACHATE COLLECTION SYSTEM
TYPICAL CELL SCHEMATIC

NO.	DATE	REVISION	APPR.

SUBMITTED
William J Smyers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR–BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SMYERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK

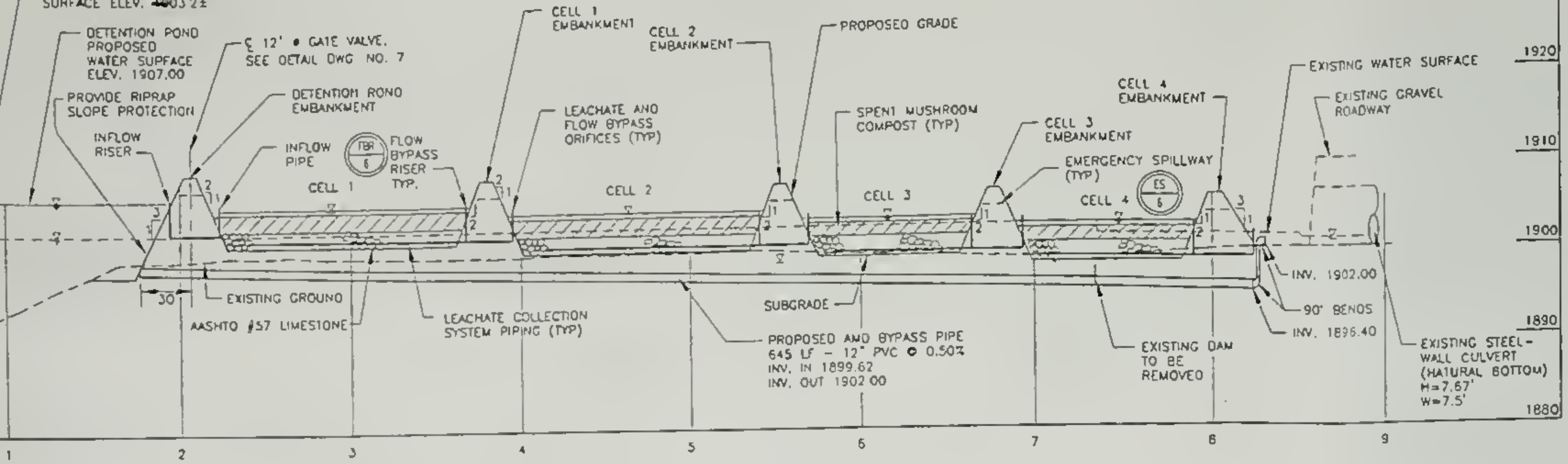
FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS

P.O. BOX 67100 HARRISBURG, PA

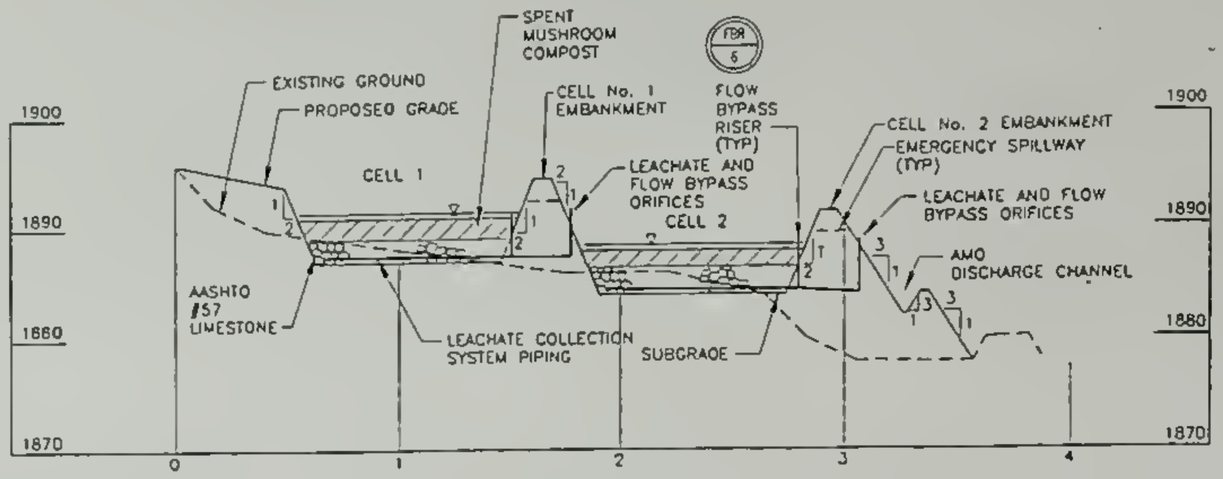
SECTIONS, SCHEDULE
AND SCHEMATICS

DRAWN BY | DATE | DRAWING NO.


SURFACE ELEV. 1903.2±
DETENTION POND PROPOSED WATER SURFACE ELEV. 1907.00
PROVIDE RIPRAP SLOPE PROTECTION
INFLOW RISER
℄ 12" ø GATE VALVE, SEE DETAIL DWG NO. 7
DETENTION POND EMBANKMENT
INFLOW PIPE
FBR 6
FLOW BYPASS RISER TYP.
CELL 1 EMBANKMENT
CELL 2 EMBANKMENT
PROPOSED GRADE
LEACHATE AND FLOW BYPASS ORIFICES (TYP)
SPENT MUSHROOM COMPOST (TYP)
CELL 3 EMBANKMENT
CELL 4 EMBANKMENT
EMERGENCY SPILLWAY (TYP)
ES 6
EXISTING WATER SURFACE
EXISTING GRAVEL ROADWAY
CELL 1
CELL 2
CELL 3
CELL 4
EXISTING GROUND
AASHTO #57 LIMESTONE
LEACHATE COLLECTION SYSTEM PIPING (TYP)
SUBGRADE
PROPOSED AMD BYPASS PIPE 645 LF – 12" PVC @ 0.50% INV. IN 1899.62 INV. OUT 1902.00
EXISTING DAM TO BE REMOVED
INV. 1902.00
90° BENDS
INV. 1896.40
EXISTING STEEL-WALL CULVERT (NATURAL BOTTOM) H=7.67' W=7.5'
30'
1920
1910
1900
1890
1880
1
2
3
4
5
6
7
8
9

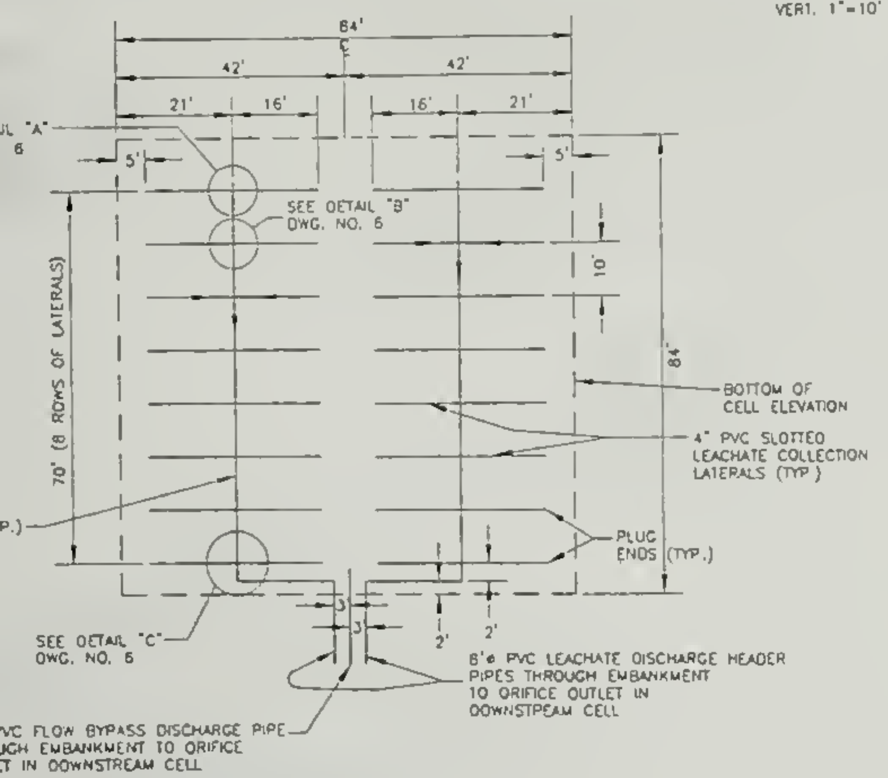
SECTION S1

SCALE: HORZ. 1"=50'
VERT. 1"=10'

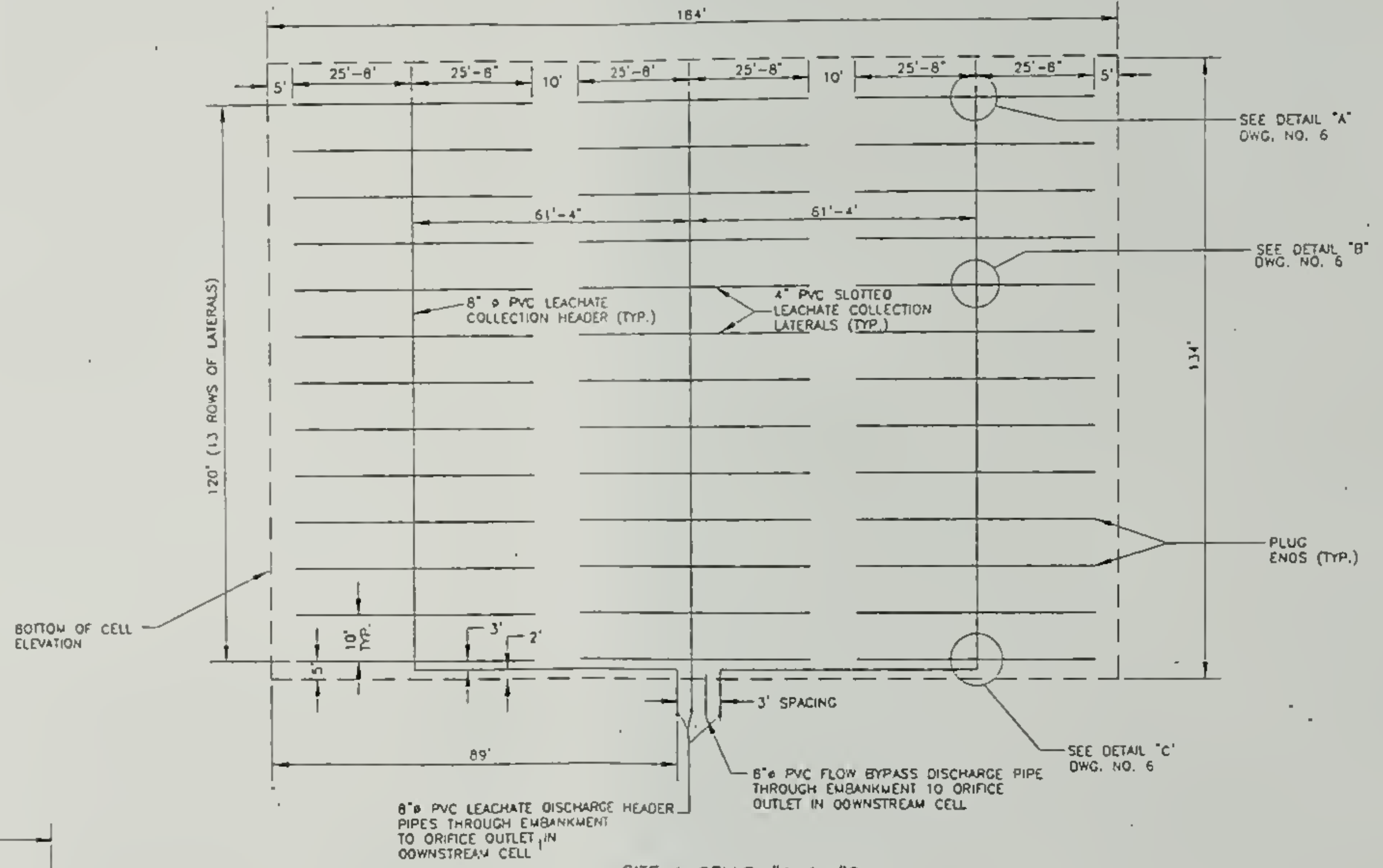


SECTION S2

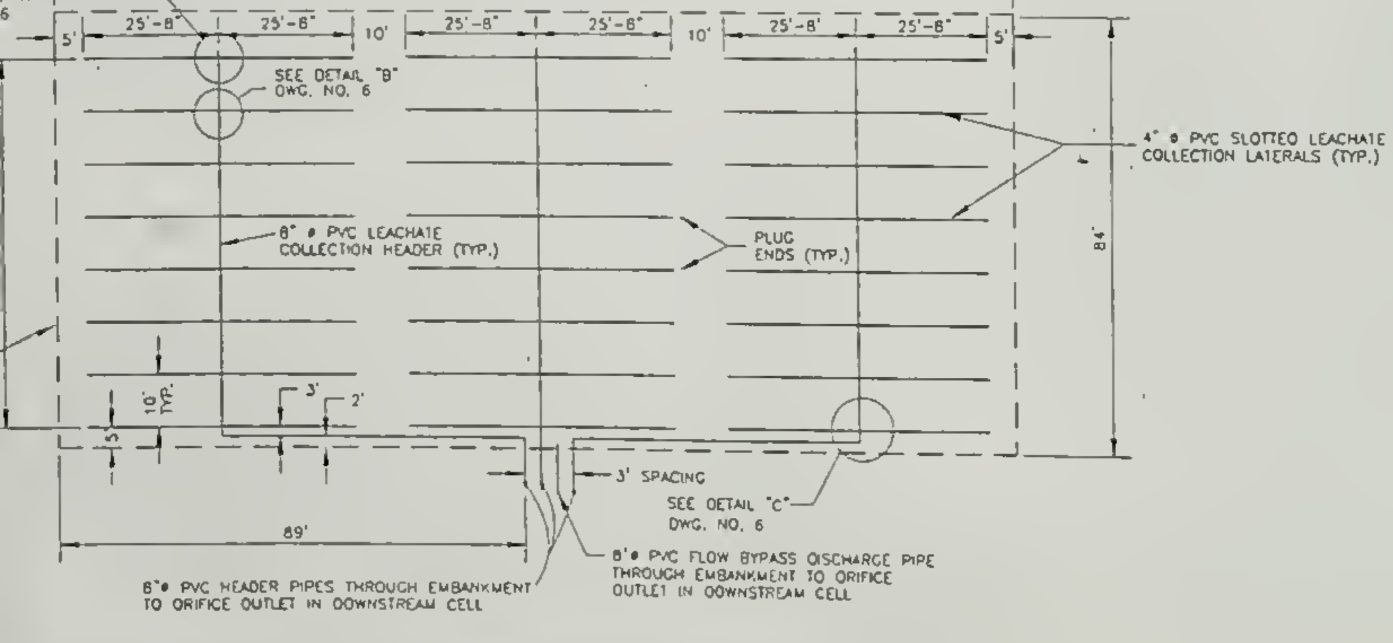
SCALE: HORZ. 1"=50'
VERT. 1"=10'


84'
42'
42'
21'
16'
16'
21'
5'
5'
10'
84'
70' (8 ROWS OF LATERALS)
SEE DETAIL "B" DWG. NO. 6
BOTTOM OF CELL ELEVATION
4" PVC SLOTTED LEACHATE COLLECTION LATERALS (TYP.)
PLUG ENDS (TYP.)
SEE DETAIL "C" DWG. NO. 6
3'
3'
2'
2'
8"ø PVC LEACHATE DISCHARGE HEADER PIPES THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL
VC FLOW BYPASS DISCHARGE PIPE UGH EMBANKMENT TO ORIFICE T IN DOWNSTREAM CELL

SITE 2 CELLS #1 & #2
LEACHATE COLLECTION SYSTEM
TYPICAL CELL SCHEMATIC
1"=20'


184'
5'
25'-8"
25'-8"
10'
25'-8"
25'-8"
10'
25'-8"
25'-8"
5'
SEE DETAIL "A" DWG. NO. 6
61'-4"
61'-4"
SEE DETAIL "B" DWG. NO. 6
8" ø PVC LEACHATE COLLECTION HEADER (TYP.)
4" PVC SLOTTED LEACHATE COLLECTION LATERALS (TYP.)
134'
120' (13 ROWS OF LATERALS)
PLUG ENDS (TYP.)
BOTTOM OF CELL ELEVATION
10' TYP.
5'
3'
2'
3' SPACING
89'
SEE DETAIL "C" DWG. NO. 6
8"ø PVC FLOW BYPASS DISCHARGE PIPE THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL
8"ø PVC LEACHATE DISCHARGE HEADER PIPES THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL

SITE 1 CELLS #1 & #2
LEACHATE COLLECTION SYSTEM
TYPICAL CELL SCHEMATIC
1"=20'


5'
25'-8"
25'-8"
10'
25'-8"
25'-8"
10'
25'-8"
25'-8"
5'
SEE DETAIL "B" DWG. NO. 6
4" ø PVC SLOTTED LEACHATE COLLECTION LATERALS (TYP.)
8" ø PVC LEACHATE COLLECTION HEADER (TYP.)
PLUG ENDS (TYP.)
84'
10' TYP.
3'
2'
5'
3' SPACING
SEE DETAIL "C" DWG. NO. 6
89'
8"ø PVC FLOW BYPASS DISCHARGE PIPE THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL
8"ø PVC HEADER PIPES THROUGH EMBANKMENT TO ORIFICE OUTLET IN DOWNSTREAM CELL

SITE 1 CELLS #3 & #4
LEACHATE COLLECTION SYSTEM

WATERWAY SCHEDULE

CHANNEL I.D.	CHANNEL DESCRIPTION	D (ft)	W (ft)	SIDE SLOPES		BOTTOM SLOPE			LINING		LO (ft)
				LEFT H:V	RIGHT H:V	FROM ELEV.	TO ELEV.	SLOPE (ft/ft)	TYPE	T (ft)	
A	SITE 1 STORMWATER INTER.	2	2	2:1	3:1	1902.00	1908.00	.1000	R-4	1.25	1
		2	2	2:1	2:1	1908.00	1910.00	.0500	R-3	0.87	1
		2	2	2:1	2:1	1910.00	1914.00	.0400	R-3	0.67	1
		2	2	2:1	2:1	1914.00	1926.00	.0200	R-3	0.67	1
		0-2	2	2:1	2:1	1926.00	1928.00	.0625	R-3	0.67	1
B	SITE 1 STORMWATER INTER.	2	2	3:1	2:1	1902.00	1908.00	.1000	R-4	1.25	1
		2	2	2:1	2:1	1908.00	1910.00	.0500	R-4	1.25	1
		2	2	2:1	2:1	1910.00	1912.00	.0400	R-3	0.67	1
		2	2	2:1	2:1	1912.00	1922.00	.0200	R-3	0.67	1
C	SITE 2 STORMWATER INTER.	2	4	2:1	2:1	1886.00	1900.00	.0400	R-4	1.25	2
D	SITE 2 AMD INFLOW	2	2	2:1	2:1	1891.00	1892.00	.0200	R-3	0.69	2

NO.	DATE	REVISION	APPR

SUBMITTED
William J. Sanger 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR–BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SNYDER

COMMONWEALTH OF PENNSYLVANIA
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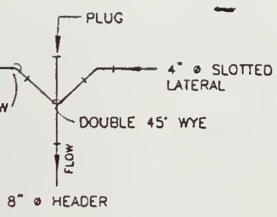
FALLS CREEK

FRANKLIN TWP. BRADFORD CO.

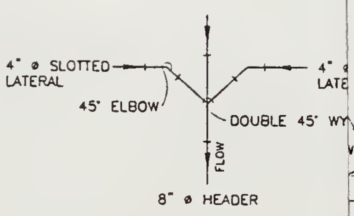
GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS

P.O. BOX 67100 HARRISBURG, PA

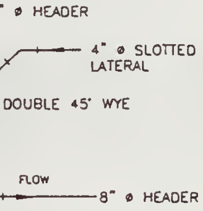
SECTIONS, SCHEDULE AND SCHEMATICS



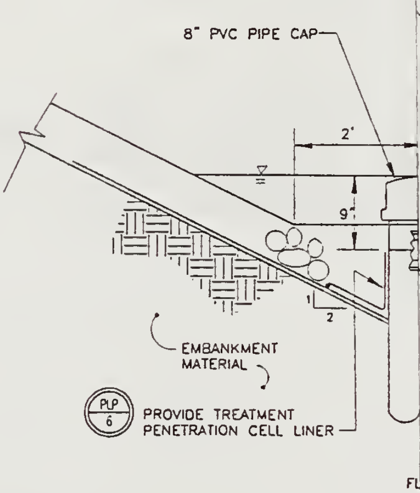
DETAIL "A"
TERMINAL END OF
EACHATE COLLECTION
SYSTEM



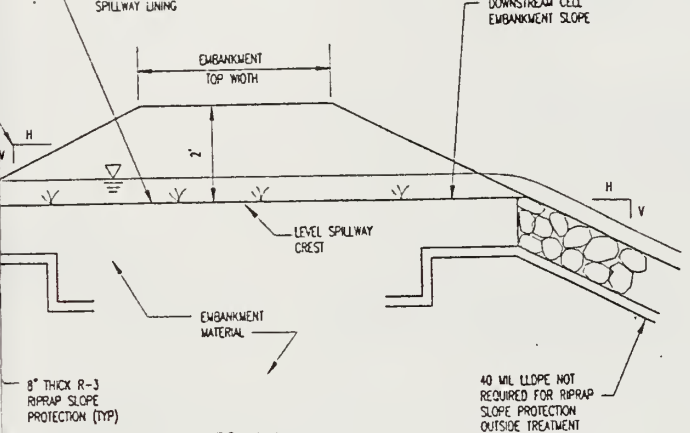
DETAIL "B"
THROUGH CONNECTI
OF LEACHATE COLLECT
SYSTEM



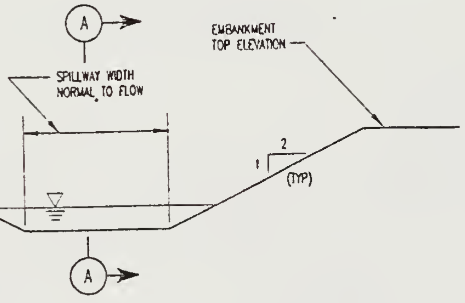
AIL "C"
D CONNECTION
TE COLLECTION
YSTEM



TYPICAL
ORIFICE OUTL
FOR LEACHATE C
FLOW BYPASS PIPING SYSTEM
NO SC

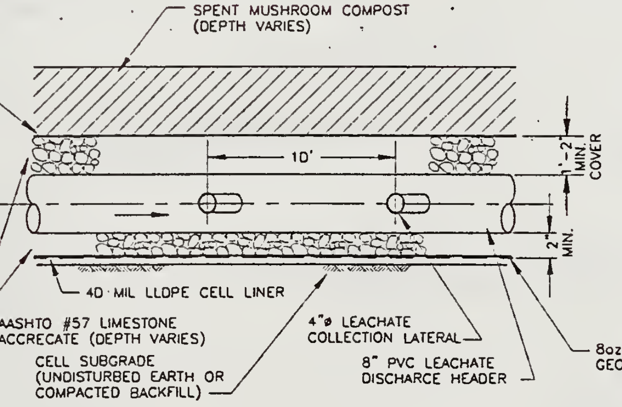

SPILLWAY LINING
DOWNSTREAM CELL EMBANKMENT SLOPE
EMBANKMENT TOP WIDTH
2'
H
V
LEVEL SPILLWAY CREST
EMBANKMENT MATERIAL
8" THICK R-3 RIPRAP SLOPE PROTECTION (TYP)
40 MIL LLDPE NOT REQUIRED FOR RIPRAP SLOPE PROTECTION OUTSIDE TREATMENT CELLS

SECTION A-A

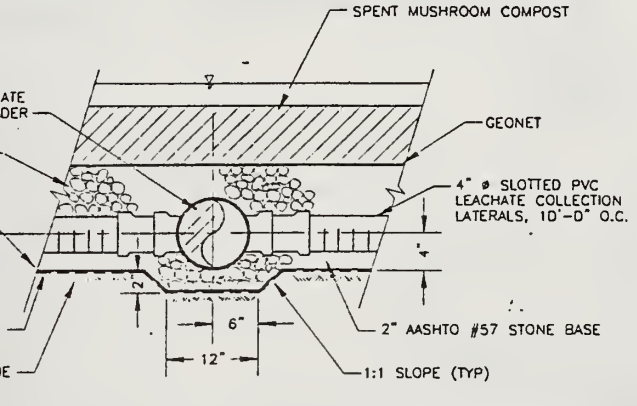


ELEVATION

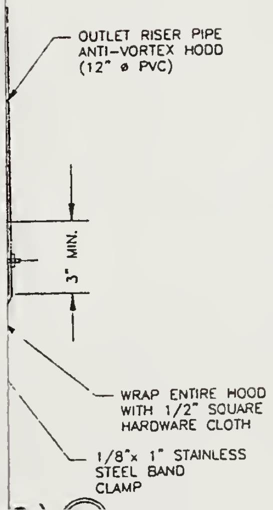
EMERGENCY SPILLWAY (TYP.) (ES)
NO SCALE


SPENT MUSHROOM COMPOST (DEPTH VARIES)
10'
1'-2' MIN. COVER
2" MIN.
40 MIL LLDPE CELL LINER
AASHTO #57 LIMESTONE ACCREGATE (DEPTH VARIES)
CELL SUBGRADE (UNDISTURBED EARTH OR COMPACTED BACKFILL)
4"ø LEACHATE COLLECTION LATERAL
8" PVC LEACHATE DISCHARGE HEADER
8oz NONWOVEN GEOTEXTILE FABR

AMD PASSIVE TREATMENT SYSTEM
TYPICAL SECTION
NO SCALE



NCH BELOW LEACHATE DISCHARGE HEADER


OUTLET RISER PIPE ANTI-VORTEX HOOD (12" ø PVC)
3" MIN.
WRAP ENTIRE HOOD WITH 1/2" SQUARE HARDWARE CLOTH
1/8"x 1" STAINLESS STEEL BAND CLAMP

NO.	DATE	REVISION	APPR.

SUBMITTED
William J. Smyers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
ENGINEER
NO 1754-E

WILLIAM JAMES SMYERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3296)101.1

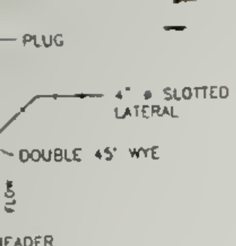
ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK

FRANKLIN TWP. BRADFORD CO

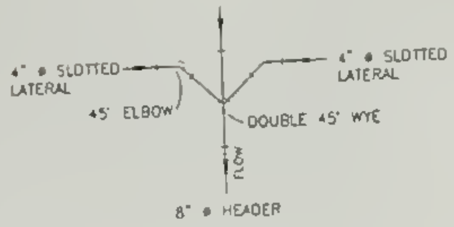
GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS

P.O. BOX 67100 HARRISBURG, PA

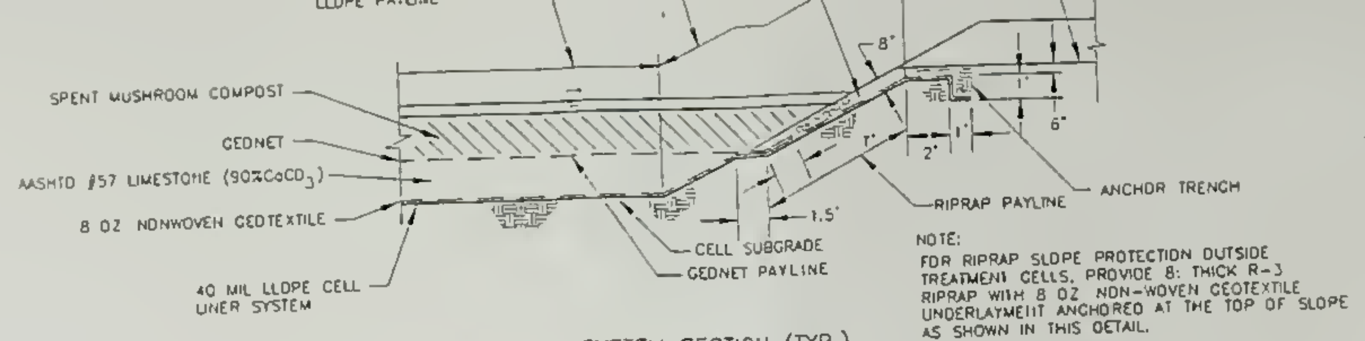
MISCELLANEOUS
DETAILS



DETAIL "A"
MINAL END OF
ATE COLLECTION
SYSTEM

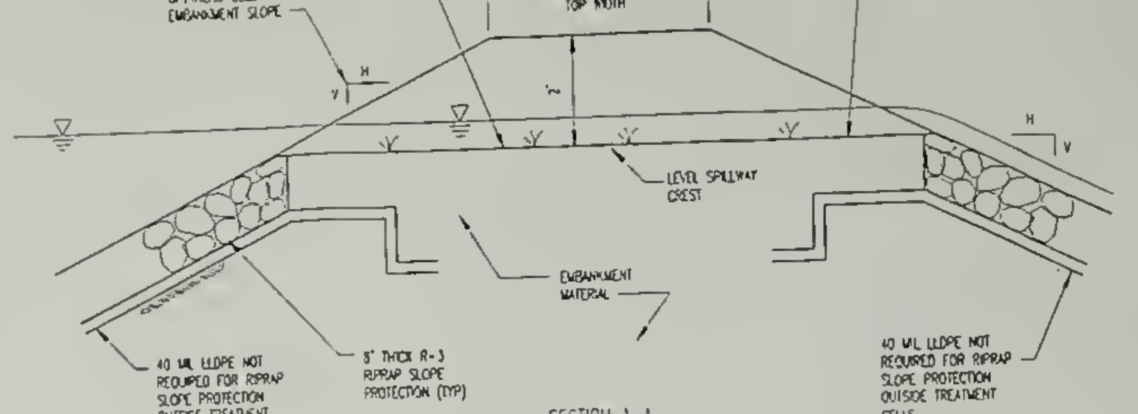


DETAIL "B"
THROUGH CONNECTION
OF LEACHATE COLLECTION
SYSTEM

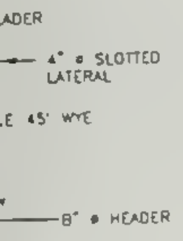


NOTE:
FOR RIPRAP SLOPE PROTECTION OUTSIDE TREATMENT CELLS, PROVIDE 8: THICK R-3 RIPRAP WITH 8 OZ NON-WOVEN GEOTEXTILE UNDERLAYMENT ANCHORED AT THE TOP OF SLOPE AS SHOWN IN THIS DETAIL.

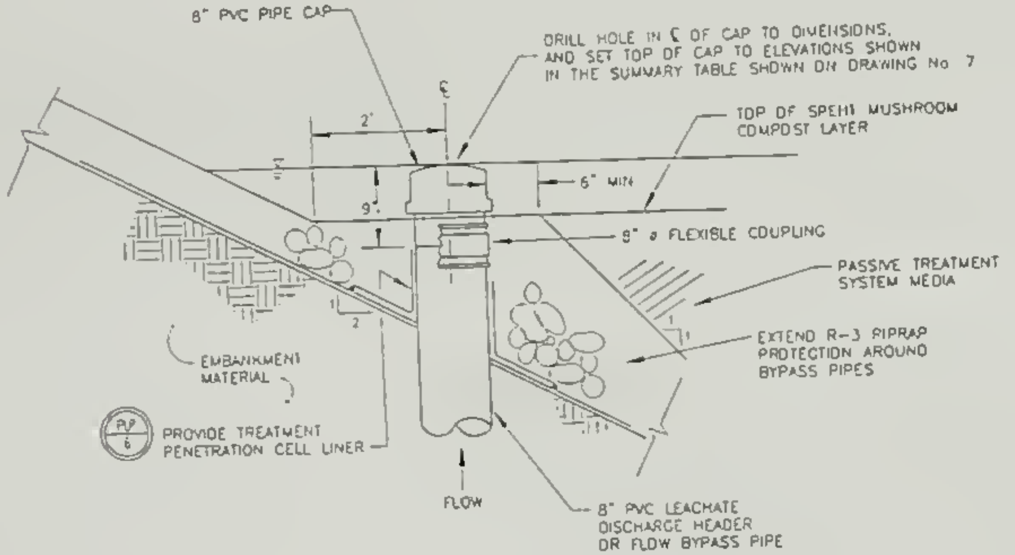
CELL LINER SYSTEM SECTION (TYP.)
NO SCALE


EMBANKMENT SLOPE
TOP WIDTH
H
V
LEVEL SPILLWAY CREST
EMBANKMENT MATERIAL
40 MIL LLDPE NOT REQUIRED FOR RIPRAP SLOPE PROTECTION OUTSIDE TREATMENT CELLS
8" THICK R-3 RIPRAP SLOPE PROTECTION (TYP)
40 MIL LLDPE NOT REQUIRED FOR RIPRAP SLOPE PROTECTION OUTSIDE TREATMENT CELLS

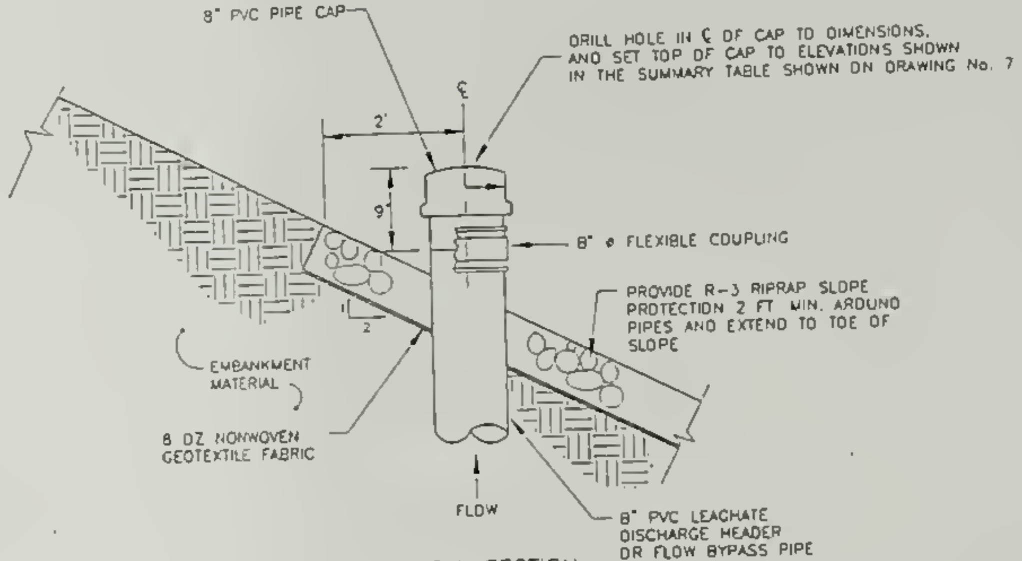
SECTION A-A



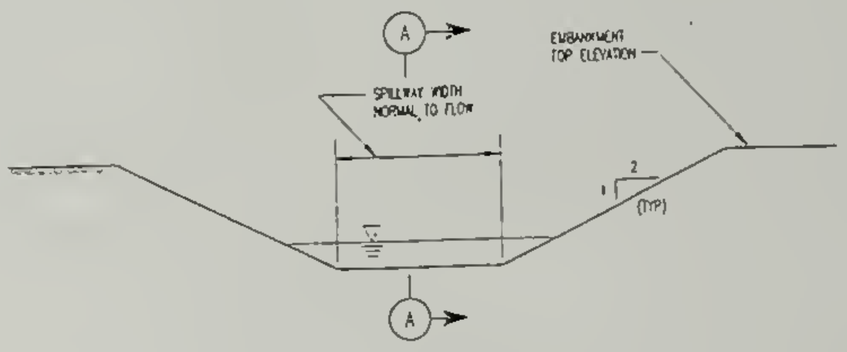
"C"
CONNECTION
COLLECTION
EM


8" PVC PIPE CAP
DRILL HOLE IN ℄ OF CAP TO DIMENSIONS, AND SET TOP OF CAP TO ELEVATIONS SHOWN IN THE SUMMARY TABLE SHOWN ON DRAWING No 7
℄
2'
9"
TOP OF SPENT MUSHROOM COMPOST LAYER
6" MIN
8" ⌀ FLEXIBLE COUPLING
PASSIVE TREATMENT SYSTEM MEDIA
EXTEND R-3 RIPRAP PROTECTION AROUND BYPASS PIPES
EMBANKMENT MATERIAL
PVP 6
PROVIDE TREATMENT PENETRATION CELL LINER
FLOW
8" PVC LEACHATE DISCHARGE HEADER OR FLOW BYPASS PIPE
1
2

TYPICAL SECTION
ORIFICE OUTLET CONTOL
FOR LEACHATE COLLECTION AND
FLOW BYPASS PIPING SYSTEMS WITHIN TREATMENT CELLS
NO SCALE

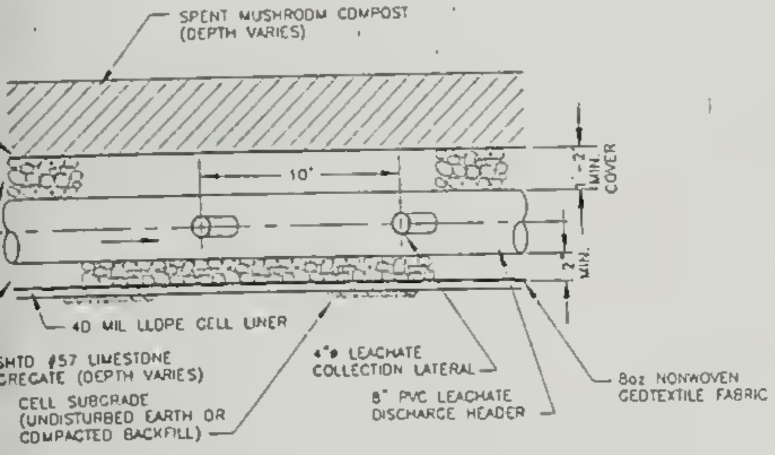

8" PVC PIPE CAP
DRILL HOLE IN ℄ OF CAP TO DIMENSIONS, AND SET TOP OF CAP TO ELEVATIONS SHOWN IN THE SUMMARY TABLE SHOWN ON DRAWING No. 7
℄
2'
9"
8" ⌀ FLEXIBLE COUPLING
PROVIDE R-3 RIPRAP SLOPE PROTECTION 2 FT MIN. AROUND PIPES AND EXTEND TO TOE OF SLOPE
EMBANKMENT MATERIAL
8 OZ NONWOVEN GEOTEXTILE FABRIC
FLOW
8" PVC LEACHATE DISCHARGE HEADER OR FLOW BYPASS PIPE
1
2

TYPICAL SECTION
ORIFICE OUTLET CONTOL
FOR LEACHATE COLLECTION AND
FLOW BYPASS PIPING SYSTEMS OUTSIDE TREATMENT CELLS
NO SCALE

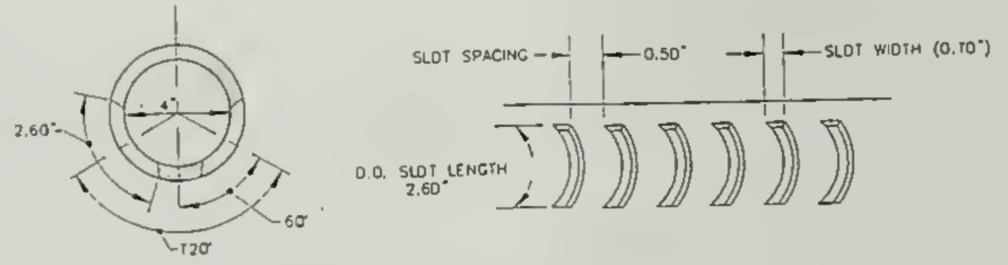


ELEVATION

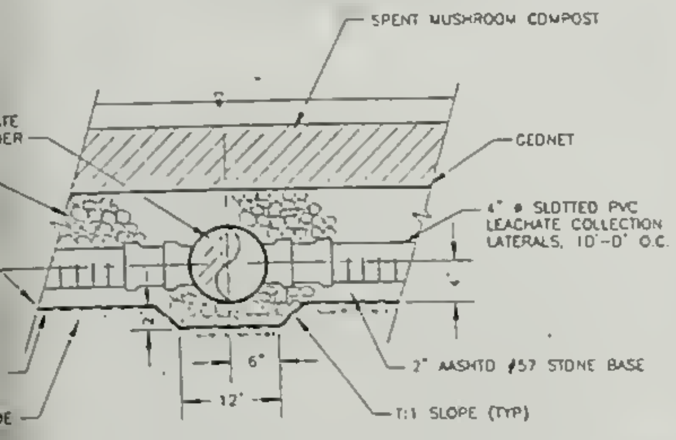
EMERGENCY SPILLWAY (TYP.) ES
NO SCALE

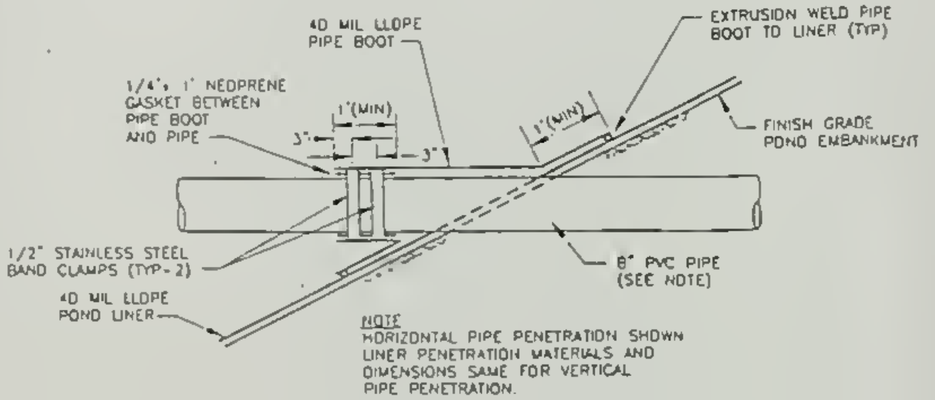

SPENT MUSHROOM COMPOST (DEPTH VARIES)
10'
1'-2' MIN. COVER
2' MIN.
40 MIL LLDPE CELL LINER
SHTO #57 LIMESTONE GREGATE (DEPTH VARIES)
CELL SUBGRADE (UNDISTURBED EARTH OR COMPACTED BACKFILL)
4"⌀ LEACHATE COLLECTION LATERAL
8" PVC LEACHATE DISCHARGE HEADER
8oz NONWOVEN GEOTEXTILE FABRIC

AMD PASSIVE TREATMENT SYSTEM
TYPICAL SECTION
NO SCALE

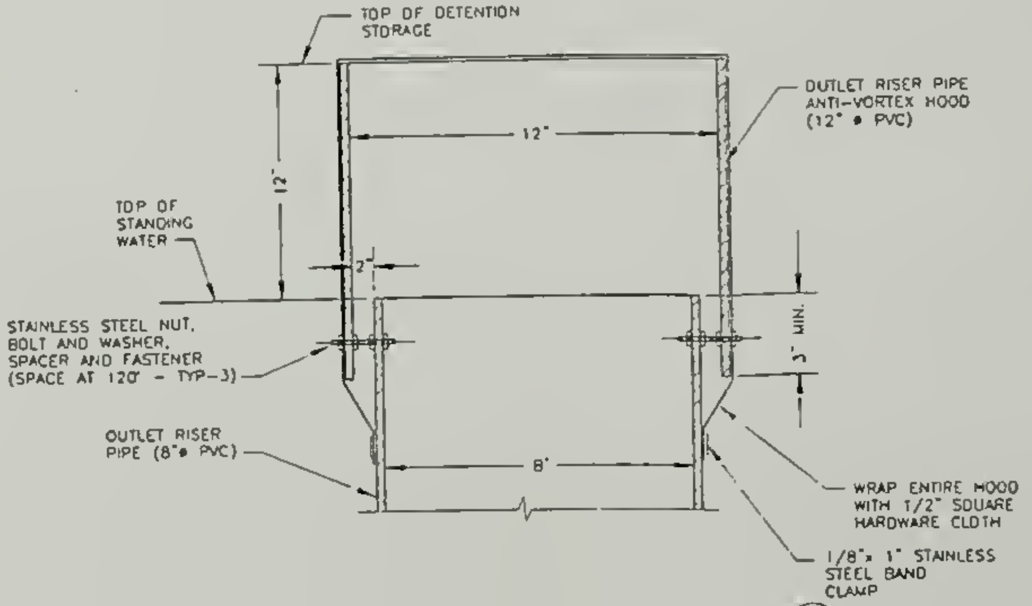


TYPICAL SECTION
4" DIA. LEACHATE COLLECTION PIPE
PERFORATION DETAIL
NO SCALE




40 MIL LLDPE PIPE BOOT
EXTRUSION WELD PIPE BOOT TO LINER (TYP)
1/4"x 1" NEOPRENE GASKET BETWEEN PIPE BOOT AND PIPE
1"(MIN)
3"
3"
1"(MIN)
FINISH GRADE POND EMBANKMENT
1/2" STAINLESS STEEL BAND CLAMPS (TYP-2)
40 MIL LLDPE POND LINER
8" PVC PIPE (SEE NOTE)

NOTE
HORIZONTAL PIPE PENETRATION SHOWN LINER PENETRATION MATERIALS AND DIMENSIONS SAME FOR VERTICAL PIPE PENETRATION.


TOP OF DETENTION STORAGE
OUTLET RISER PIPE ANTI-VORTEX HOOD (12" ⌀ PVC)
12"
12"
TOP OF STANDING WATER
2"
3" MIN.
STAINLESS STEEL NUT, BOLT AND WASHER, SPACER AND FASTENER (SPACE AT 120° - TYP-3)
OUTLET RISER PIPE (8"⌀ PVC)
8"
WRAP ENTIRE HOOD WITH 1/2" SQUARE HARDWARE CLOTH
1/8"x 1" STAINLESS STEEL BAND CLAMP

NO.	DATE	REVISION	APPR

SUBMITTED
7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SYTERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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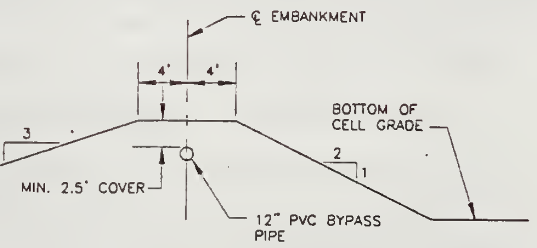
ABATEMENT PROJECT
FALLS CREEK
FRANKLIN TWP. BRADFORD CO

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

MISCELLANEOUS
DETAILS

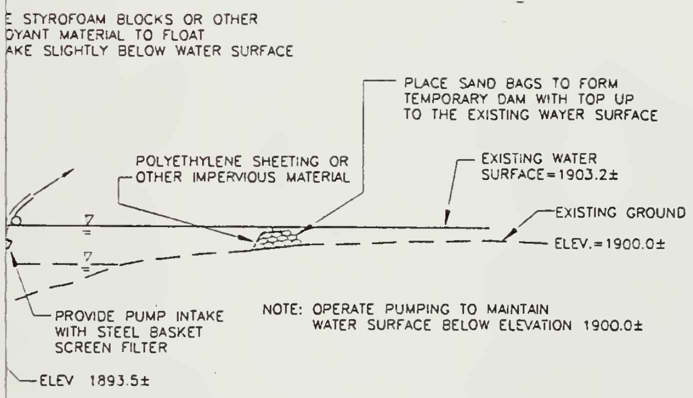
GENERAL DIMENSIONS			TREATMENT MEDIA DIMENSIONS				
RADE EV	TOP OF EMBANKMENT ELEV	EMBANKMENT TOP WOTH	AASHTO#57 LIMESTONE DEPTH	SPENT MUSHROOM COMPOST DEPTH	WETLAND WATER DEPTH	4" SLOTTED COLLECTION PIPE INV ELEV	8" DISCHA HEADE INV EL
(FT-MSL)		(FT)		(FT-MSL)			(FT-MS
RIES	1910.00	8.00	---	---	---	---	---
1.50	1909.00	8.00	2.00	2.00	0.50	1901.67	1901.5
0.50	1908.00	8.00	2.00	2.00	0.50	1900.67	1900.5
9.50	1907.00	8.00	2.50	1.50	0.50	1899.67	1899.5
8.50	1906.00	8.00	2.50	1.50	0.50	1898.67	1898.5

GENERAL DIMENSIONS			TREATMENT MEDIA DIMENSIONS				
RADE EV	TOP OF EMBANKMENT ELEV	EMBANKMENT TOP WIDTH	AASHTO#57 LIMESTONE DEPTH	SPENT MUSHROOM COMPOST DEPTH	WETLAND WATER DEPTH	4" SLOTTED COLLECTION PIPE INV ELEV	8" DISCHA HEADE INV EL
(FT-MSL)		(FT)		(FT)			(FT-MS
7.00	1894.50	8.00	2.00	2.00	0.50	1887.17	1887.0
4.00	1891.50	8.00	2.00	1.50	0.50	1884.17	1884.0



TYPICAL SECTION CELL BYPASS PIPE (BP)

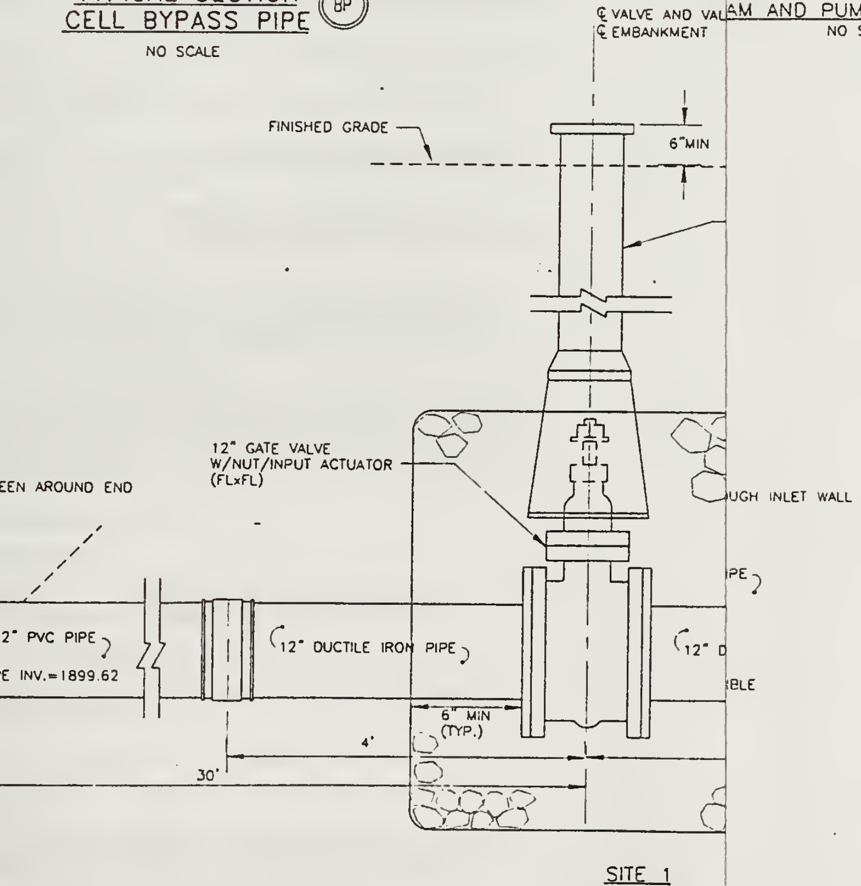
NO SCALE



E STYROFOAM BLOCKS OR OTHER
OYANT MATERIAL TO FLOAT
AKE SLIGHTLY BELOW WATER SURFACE
PLACE SAND BAGS TO FORM TEMPORARY DAM WITH TOP UP TO THE EXISTING WAYER SURFACE
POLYETHYLENE SHEETING OR OTHER IMPERVIOUS MATERIAL
EXISTING WATER SURFACE=1903.2±
EXISTING GROUND
ELEV.=1900.0±
PROVIDE PUMP INTAKE WITH STEEL BASKET SCREEN FILTER
NOTE: OPERATE PUMPING TO MAINTAIN WATER SURFACE BELOW ELEVATION 1900.0±
ELEV 1893.5±

TEMPORARY SANDBAG
AM AND PUMPING APPARATUS (SBD)

NO SCALE



SITE 1
AMD BYPASS PIPE IN
STRUCTURE WITH C

NO.	DATE	REVISION	APPR.

SUBMITTED
William J. Sayers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SAYERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK

FRANKLIN TWP. BRADFORD CO.

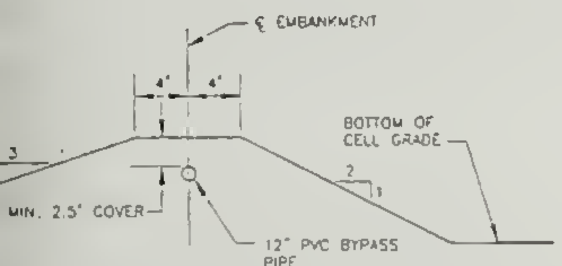
GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

MISCELLANEOUS DETAILS & SCHEDULES

GENERAL DIMENSIONS		TREATMENT MEDIA DIMENSIONS			LEACHATE COLLECTION AND DISCHARGE SYSTEM DIMENSIONS							FLOW BYPASS RISER AND DISCHARGE PIPE DIMENSIONS					EMERGENCY SPILLWAY DIMENSIONS		
TOP OF EMBANKMENT ELEV	EMBANKMENT TOP WIDTH	AASHTO #57 LIMESTONE DEPTH	SPENT MUSHROOM COMPOST DEPTH	WETLAND WATER DEPTH	4" SLOTTED COLLECTION PIPE INV. ELEV	8" DISCHARGE HEADER INV. ELEV	8" DISCHARGE HEADER OUTLET ORIFICE C/L ELEV	OUTLET ORIFICE DIA	LEACHATE DESIGN DISCHARGE RATE (TOTAL)	DISCHARGE PER HEADER	NUMBER OF HEADERS	8" RISER CREST ELEV	8" DISCHARGE PIPE INV ELEV	8" DISCHARGE PIPE OUTLET ORIFICE C/L ELEV	OUTLET ORIFICE DIA	BYPASS DESIGN DISCHARGE RATE	CREST ELEV	SPILLWAY WIDTH NORMAL TO FLOW	SPILLWAY DEPTH
(FT–MSL)	(FT)	(FT–MSL)			(FT–MSL)			(IN)	(GPM)			(FT–MSL)			(IN)	(GPM)	(FT–MSL)	(FT)	
1910.00	5.00	---	---	---	---	---	---	---	---	---	---	1911.00	1902.50	1906.00	---	600	1908.00	8	2
1909.00	8.00	2.00	2.00	0.50	1901.87	1901.50	1905.83	1.50	90	30	3	1904.00	1901.50	1905.00	7.00	510	1907.00	8	2
1904.00	9.00	2.00	2.00	0.50	1900.87	1900.50	1904.83	2.00	150	50	2	1905.00	1900.50	1904.00	6.50	450	1906.00	8	2
1907.00	8.00	2.50	1.50	0.50	1899.87	1899.50	1903.83	2.00	150	50	3	1904.00	1899.50	1903.00	6.50	450	1905.00	8	2
1906.00	6.00	2.50	1.50	0.50	1895.87	1898.50	1912.83	2.00	150	50	3	1903.00	1898.50	1902.00	6.50	450	1904.00	8'	2

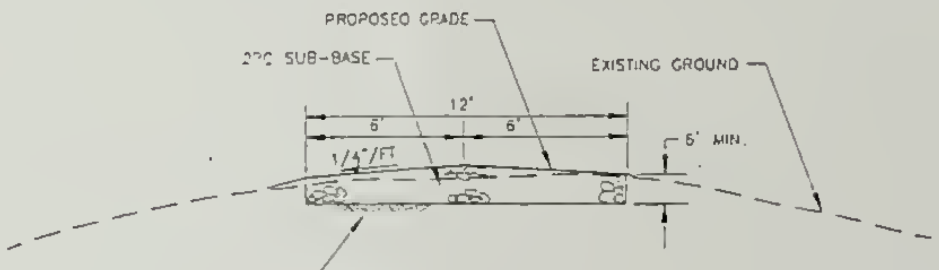
SITE 2 AND PASSIVE TREATMENT SYSTEM

GENERAL DIMENSIONS		TREATMENT MEDIA DIMENSIONS			LEACHATE COLLECTION AND DISCHARGE SYSTEM DIMENSIONS							FLOW BYPASS RISER AND DISCHARGE PIPE DIMENSIONS					EMERGENCY SPILLWAY DIMENSIONS		
TOP OF EMBANKMENT ELEV	EMBANKMENT TOP WIDTH	AASHTO #57 LIMESTONE DEPTH	SPENT MUSHROOM COMPOST DEPTH	WETLAND WATER DEPTH	4" SLOTTED COLLECTION PIPE INV. ELEV	8" DISCHARGE HEADER INV. ELEV	8" DISCHARGE HEADER OUTLET ORIFICE C/L ELEV	OUTLET ORIFICE DIA	LEACHATE DESIGN DISCHARGE RATE (TOTAL)	DISCHARGE PER HEADER	NUMBER OF HEADERS	8" RISER CREST ELEV	8" DISCHARGE PIPE INV ELEV	8" DISCHARGE PIPE OUTLET ORIFICE C/L ELEV	OUTLET ORIFICE DIA	BYPASS DESIGN DISCHARGE RATE	CREST ELEV	SPILLWAY WIDTH NORMAL TO FLOW	SPILLWAY DEPTH
(FT–MSL)	(FT)	(FT)			(FT–MSL)			(IN)	(GPM)			(FT–MSL)			(IN)	(GPM)	(FT–MSL)	(FT)	
1894.50	5.00	2.00	2.00	0.50	1887.17	1887.00	1891.33	1.25	40	20	2	1891.50	1887.00	1888.50	3.00	60	1892.50	8	2
1891.50	8.00	2.00	1.50	0.50	1884.17	1884.00	1888.33	1.75	50	40	2	1888.50	1884.00	1882.50	1.00	70	1889.50	8	2



TYPICAL SECTION CELL BYPASS PIPE (BP)

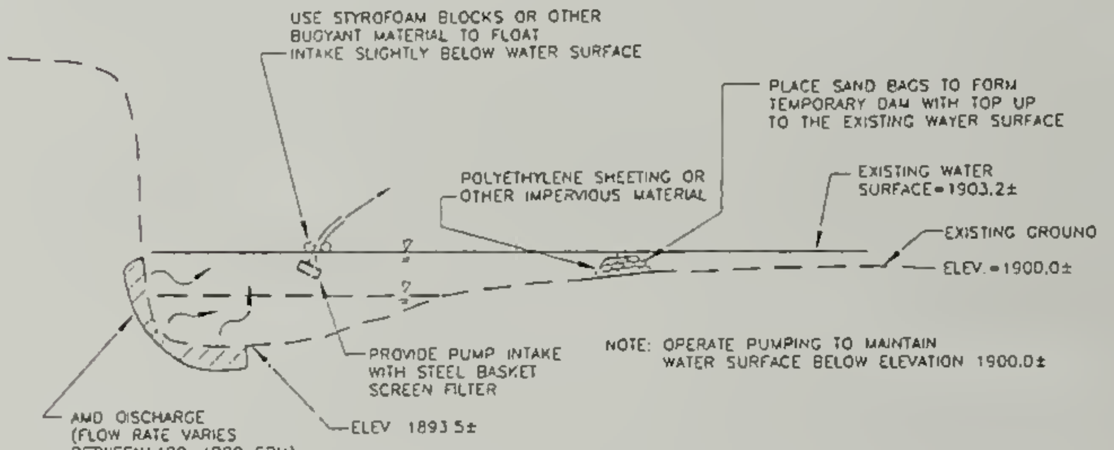
NO SCALE



NOTE
LOCATE ROADWAY ALONG RIDGE TOPOGRAPHY TO MINIMIZE INCIDENCE OF ROAD EROSION DUE TO STORMWATER RUN-ON

TYPICAL SECTION MAINTENANCE ROAD (MR)

NO SCALE

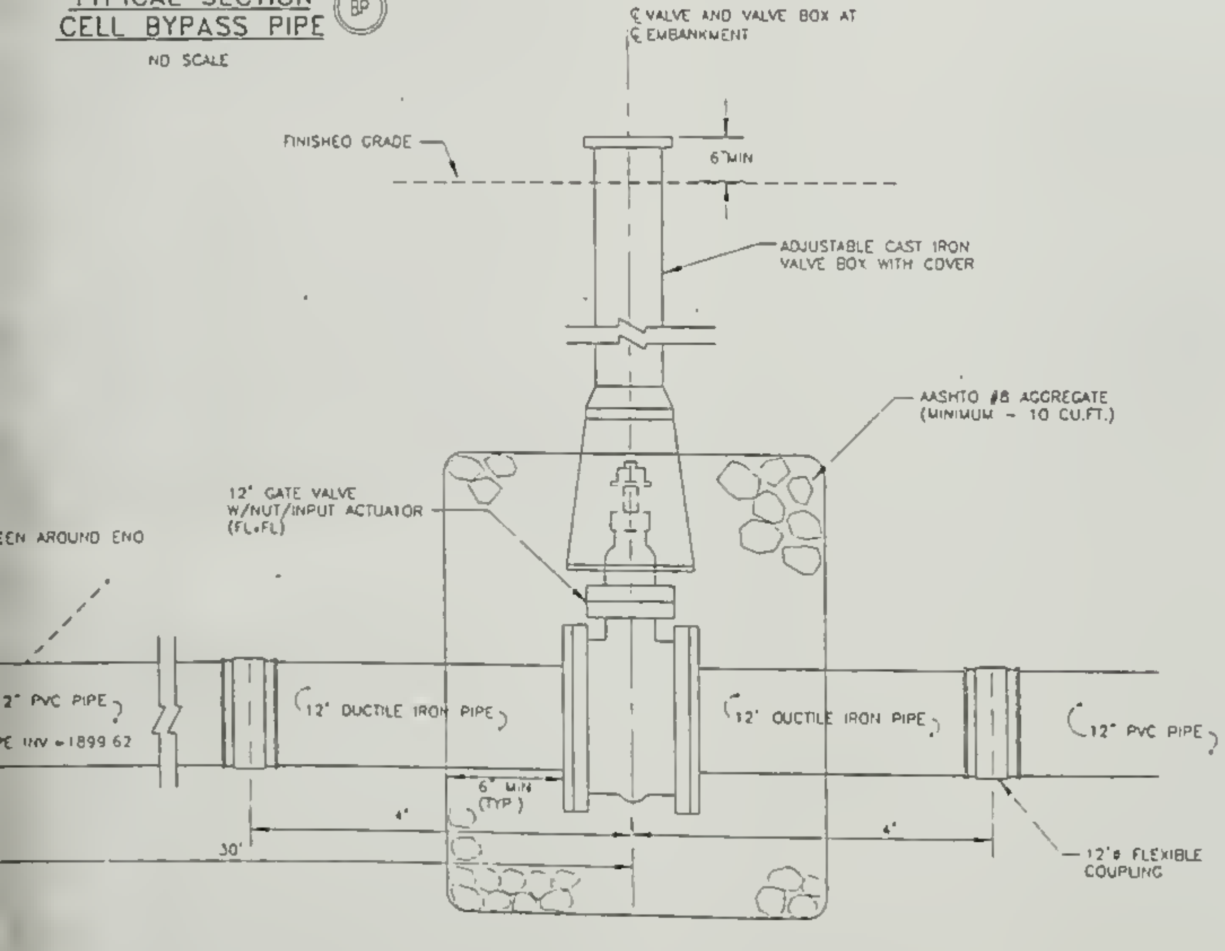


USE STYROFOAM BLOCKS OR OTHER BUOYANT MATERIAL TO FLOAT INTAKE SLIGHTLY BELOW WATER SURFACE
PLACE SAND BAGS TO FORM TEMPORARY DAM WITH TOP UP TO THE EXISTING WAYER SURFACE
POLYETHYLENE SHEETING OR OTHER IMPERVIOUS MATERIAL
EXISTING WATER SURFACE=1903.2±
EXISTING GROUND
ELEV.=1900.0±
PROVIDE PUMP INTAKE WITH STEEL BASKET SCREEN FILTER
AMD DISCHARGE (FLOW RATE VARIES BETWEEN 100–1000 GPM)
ELEV 1893.5±

NOTE: OPERATE PUMPING TO MAINTAIN WATER SURFACE BELOW ELEVATION 1900.0±

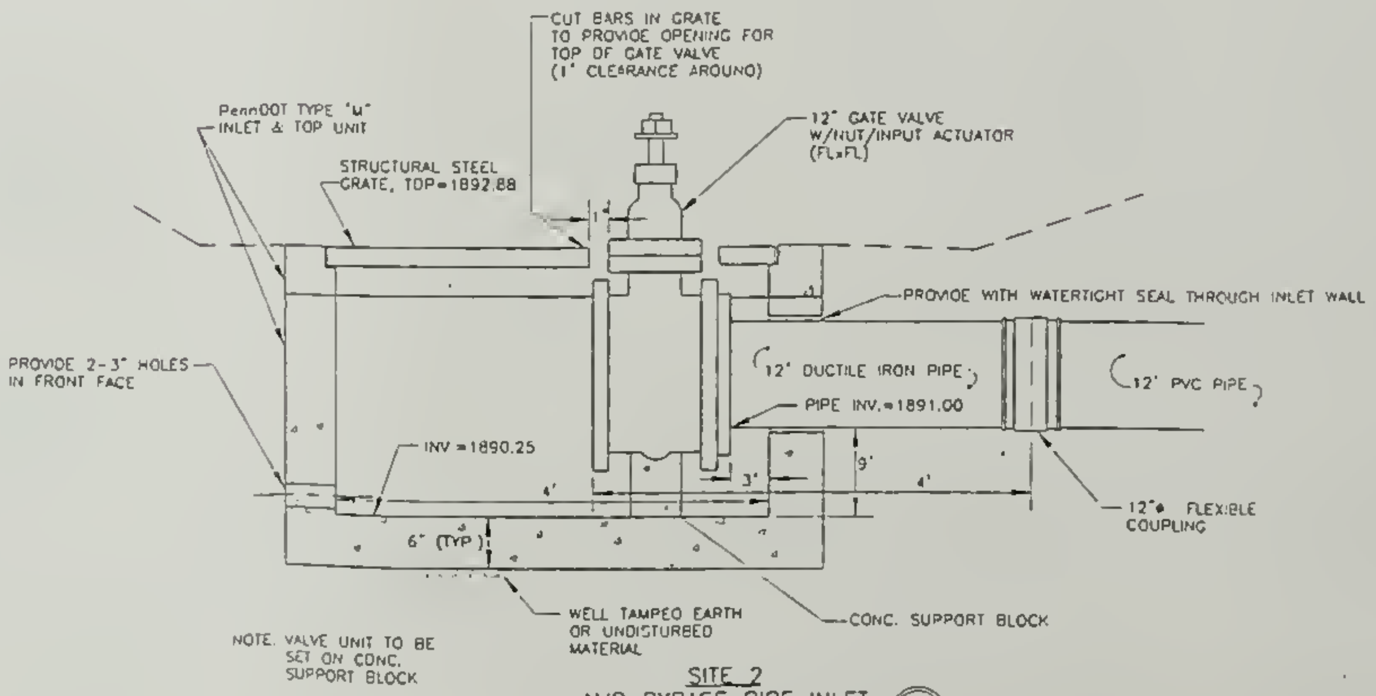
TEMPORARY SANDBAG DAM AND PUMPING APPARATUS (SBD)

NO SCALE



℄ VALVE AND VALVE BOX AT ℄ EMBANKMENT
FINISHED GRADE
6" MIN
ADJUSTABLE CAST IRON VALVE BOX WITH COVER
AASHTO #8 AGGREGATE (MINIMUM – 10 CU.FT.)
12" GATE VALVE W/NUT/INPUT ACTUATOR (FL×FL)
EEN AROUND END
2" PVC PIPE
E INV.=1899.62
12" DUCTILE IRON PIPE
12" DUCTILE IRON PIPE
12" PVC PIPE
6" MIN (TYP.)
4'
4'
30'
12"ø FLEXIBLE COUPLING

SITE 1
AMD BYPASS PIPE INLET



CUT BARS IN GRATE TO PROVIDE OPENING FOR TOP OF GATE VALVE (1" CLEARANCE AROUND)
PennDOT TYPE "M" INLET & TOP UNIT
STRUCTURAL STEEL GRATE, TOP=1892.88
12" GATE VALVE W/NUT/INPUT ACTUATOR (FL×FL)
PROVIDE WITH WATERTIGHT SEAL THROUGH INLET WALL
PROVIDE 2-3" HOLES IN FRONT FACE
12" DUCTILE IRON PIPE
PIPE INV.=1891.00
12" PVC PIPE
INV.=1890.25
4'
3'
9'
4'
6" (TYP.)
12"ø FLEXIBLE COUPLING
WELL TAMPED EARTH OR UNDISTURBED MATERIAL
CONC. SUPPORT BLOCK
NOTE: VALVE UNIT TO BE SET ON CONC. SUPPORT BLOCK

SITE 2
AMD BYPASS PIPE INLET STRUCTURE WITH GATE SHUTOFF VALVE (GV1)

NO.	DATE	REVISION	APPR.

SUBMITTED
William J. Sayers 7/23/96
PROFESSIONAL

APPROVED
DIRECTOR BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SAYERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK
FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

MISCELLANEOUS
DETAILS & SCHEDULES

.. SEDIMENT POLLUTION CONTROL PLAN

IVE IS TO ACCOMPANY THE EROSION AND SEDIMENT CONTROL (E&SC)
ON THE DRAWINGS AND REFERENCED SECTIONS, PROFILES, AND
SHALL BE CONSIDERED AN ACTUAL PART OF SAID (E&SC) PLAN.

ERWISE EXPRESSLY STATED, THE CONTRACTOR IS RESPONSIBLE FOR THE
ION OF THIS E&SC PLAN SHOWN HEREUPON THESE DRAWINGS AND IN
WITH THE TECHNICAL SPECIFICATIONS.

TEMENT OF THE PROJECT

PURPOSE OF THE PROJECT IS TO PROVIDE WETLAND PASSIVE TREATMENT
EMS TO AID IN THE ABATEMENT OF TWO ACID MINE DRAINAGE
HARGES INTO TRIBUTARIES OF SCHRADER CREEK IN FRANKLIN TOWNSHIP,
FORD COUNTY.

PROJECT INVOLVES CLEARING AND GRADING ACTIVITIES ASSOCIATED WITH
INSTALLATION OF TWO SEPARATE WETLAND PASSIVE TREATMENT
EMS IN THE HEADWATERS OF FALLS CREEK AND LONG VALLEY RUN.

TRUCTION IS ANTICIPATED TO BEGIN IN THE FALL OF 1995, AND CONTINUE
UGH FALL OF 1996.

IATION

CREEK SITE:(SITE 1)

EXISTING SOILS THROUGHOUT THE SITE AREA ARE FROM THE
UDORTHENTS AND WELLSBORO SERIES. BOTH SOIL TYPES ARE
CONSIDERED TO BE FROM THE HYDROLOGIC SOIL GROUP C, HAVING
MODERATE RUNOFF POTENTIAL.

VALLEY RUN SITE:(SITE 2)

EXISTING SOILS THROUGHOUT THE SITE AREA ARE FROM THE WELLSBORO
SERIES. THIS SOIL TYPE IS CONSIDERED TO BE FROM THE HYDROLOGIC
SOIL GROUP C, HAVING MODERATE RUNOFF POTENTIAL.

XISTING TOPOGRAPHY IN BOTH PROJECT AREAS RANGES FROM
OXIMATELY 3 TO 50 PERCENT SLOPES. DRAINAGE PATTERNS AT BOTH
ECT SITES ARE GENERALLY DIRECTED INWARD TOWARD THE PROPOSED
AND PASSIVE TREATMENT SYSTEMS FROM THE NORTH, WEST, AND
H.

ND COVER THROUGHOUT BOTH PROJECT AREAS CONSISTS MAINLY OF
GRASSLANDS CREATED DURING RECLAMATION OF MINED AREAS. A
E PORTION OF THE DRAINAGE AREA TRIBUTARY TO THE FALLS CREEK
ECT SITE IS WOODED.

SION AND SEDIMENT CONTROL REQUIREMENTS

L CASES, THE SMALLEST PRACTICAL AREA OF STABLE LAND SURFACE WILL
ISTURBED TO COMPLETE THE REQUIRED WORK. PRIOR TO BEGINNING ANY
VATION ACTIVITY, THE OUTER LIMITS OF THE CONTRACTOR'S WORK AREA
L BE CLEARLY MARKED BY USING STAKES, PAINT, OR FLAGGING.

LEARING AND GRUBBING DEBRIS ACCUMULATION WILL BE PROPERLY
OSED OF IN A LAWFUL MANNER.

VATED TRENCH MATERIAL WILL BE PLACED UPSLOPE FROM THE
VATION WHENEVER POSSIBLE. SILT FENCE WILL BE INSTALLED ALONG
NSLOPE TOE OF SOIL PILES.

Y EXCAVATIONS WILL BE OPEN ONLY LONG ENOUGH TO PROPERLY
LL AND INSPECT ALL UNDERGROUND FACILITIES IN ACCORDANCE WITH
ICABLE SPECIFICATIONS.

REAS REQUIRING INTERIM OR FINAL STABILIZATION MUST BE ADDRESSES
N 72 HOURS OF COMPLETION OF DISTURBANCE. AREAS UTILIZING
TATIVE STABILIZATION MUST BE SEEDED/PLANTED IN SUFFICIENT TIME TO
INATE BY OCTOBER 15 OF EACH YEAR. SEEDING WILL BE ACCOMPLISHED
UGH THE USE OF HYDROSEEDING TECHNIQUES OR CONVENTIONAL SEEDING
MULCHING AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS AND
IONS E AND F OF THIS NARRATIVE.

STOCKPILES ARE TO BE SEEDED AND MULCHED IF THEY ARE TO REMAIN
MORE THAN 72 HOURS.

TIME WILL SEDIMENT BE ALLOWED TO LEAVE THE SITE AND ENTER
MONWEALTH WATERS.

LERATED EROSION AND SEDIMENTATION WILL BE LIMITED BY STABILIZING
DISTURBED AREAS AS SOON AS POSSIBLE AND BY KEEPING THE AMOUNT
ISTURBED AREA TO A MINIMUM.

ENTATION CAUSED BY CONSTRUCTION WILL BE CONTAINED BY SILT
ES AND OTHER TEMPORARY EROSION AND SEDIMENT POLLUTION CONTROL
URES. GRASS WILL BE SEEDED AND MAINTAINED IMMEDIATELY AFTER
GRADING OF ANY AREA.

ROSION AND SEDIMENTATION CONTROL FACILITY REQUIRED OR
SSARY TO PROTECT AREAS FROM EROSION DURING THE STABILIZATION
OD SHALL BE MAINTAINED UNTIL STABILIZATION IS COMPLETED. UPON
PLETION OF STABILIZATION, ALL UNNECESSARY OR UNUSABLE CONTROL
URES AND FACILITIES SHALL BE REMOVED, THE AREAS SHALL BE GRADED
THE SOILS SHALL BE STABILIZED.

&SC PLAN MUST BE IMPLEMENTED PRIOR TOO, DURING AND AFTER EACH
H DISTURBANCE ACTIVITY. THE PROJECT SITE SHALL AT ALL TIMES BE
ABLE FOR INSPECTION BY AUTHORIZED EMPLOYEES OF THE DEPARTMENT
NVIRONMENTAL PROTECTION (PADEP) OR THE BRADFORD COUNTY
ERVATION DISTRICT. THE E&SC PLAN SHALL ALWAYS BE AVAILABLE AT
CONSTRUCTION SITE.

EARTHMOVING ACTIVITIES

CTION ACTIVITIES

R SHALL NOTIFY THE BRADFORD COUNTY CONSERVATION DISTRICT AT
T SEVEN (7) DAYS BEFORE BEGINNING EARTHMOVING ACTIVITIES,
UDING CLEARING AND GRUBBING.

DULE CONSTRUCTION SO THAT GRADING OPERATIONS CAN BEGIN AND
AS QUICKLY AS POSSIBLE.

LY MARK THE LIMITS OF DISTURBANCE, OR CONTRACTOR'S WORK AREA,
FLAGS, SIGNS, ETC.

ON OF FALLS CREEK (SITE 1) AMD PASSIVE WETLAND TREATMENT SYSTEM

DULE CONSTRUCTION ACTIVITIES DURING DRY WEATHER CONDITIONS
IEVER POSSIBLE.

TRUCT PERMANENT STORMWATER INTERCEPTOR CHANNELS "A" AND "B"
G THE NORTHERN AND SOUTHERN PERIMETERS OF THE CONSTRUCTION
STABILIZE THE CHANNELS WITH RIP RAP LININGS AS SPECIFIED IN THE
RWAY SCHEDULE PROVIDED ON DRAWING NO. 5.

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E. TEMPOR

1. SILT F

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c.

d.

e.

NO.	DATE	REVISION	APPR.

SUBMITTED
7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
NO 1154-E

WILLIAM JAMES SMYERS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK

FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS

P.O. BOX 67100 HARRISBURG, PA

ERDSION & SEDIMENT
CONTROL - NARRATIVE

S SEDIMENT POLLUTION CONTROL PLAN

IS TO ACCOMPANY THE EROSION AND SEDIMENT CONTROL (E&SC)
THE DRAWINGS AND REFERENCED SECTIONS, PROFILES, AND
ALL BE CONSIDERED AN ACTUAL PART OF SAID (E&SC) PLAN

ISE EXPRESSLY STATED, THE CONTRACTOR IS RESPONSIBLE FOR THE
OF THIS E&SC PLAN SHOWN HEREUPON THESE DRAWINGS AND IN
H THE TECHNICAL SPECIFICATIONS.

ENT OF THE PROJECT

POSE OF THE PROJECT IS TO PROVIDE WETLAND PASSIVE TREATMENT
TO AID IN THE ABATEMENT OF TWO ACID MINE DRAINAGE
GES INTO TRIBUTARIES OF SCHRADER CREEK IN FRANKLIN TOWNSHIP,
RO COUNTY.

JECT INVOLVES CLEARING AND GRADING ACTIVITIES ASSOCIATED WITH
TALLATION OF TWO SEPARATE WETLAND PASSIVE TREATMENT
IN THE HEADWATERS OF FALLS CREEK AND LONG VALLEY RUN.

CTION IS ANTICIPATED TO BEGIN IN THE FALL OF 1995, AND CONTINUE
H FALL OF 1996.

ON

REEK SITE (SITE 1)

XISTING SOILS THROUGHOUT THE SITE AREA ARE FROM THE
OORTHENTS AND WELLSBORO SERIES. BOTH SOIL TYPES ARE
ONSIDERED TO BE FROM THE HYDROLOGIC SOIL GROUP C, HAVING
ODERATE RUNOFF POTENTIAL.

ALLEY RUN SITE (SITE 2)

XISTING SOILS THROUGHOUT THE SITE AREA ARE FROM THE WELLSBORO
ERIES. THIS SOIL TYPE IS CONSIDERED TO BE FROM THE HYDROLOGIC
OIL GROUP C, HAVING MODERATE RUNOFF POTENTIAL.

STING TOPOGRAPHY IN BOTH PROJECT AREAS RANGES FROM
IMATELY 3 TO 50 PERCENT SLOPES. DRAINAGE PATTERNS AT BOTH
T SITES ARE GENERALLY DIRECTED INWARD TOWARD THE PROPOSED
D PASSIVE TREATMENT SYSTEMS FROM THE NORTH, WEST, AND

COVER THROUGHOUT BOTH PROJECT AREAS CONSISTS MAINLY OF
GRASSLANDS CREATED DURING RECLAMATION OF MINED AREAS. A
PORTION OF THE DRAINAGE AREA TRIBUTARY TO THE FALLS CREEK
T SITE IS WOODED.

ON AND SEDIMENT CONTROL REQUIREMENTS

EASES, THE SMALLEST PRACTICAL AREA OF STABLE LAND SURFACE WILL
TURBED TO COMPLETE THE REQUIRED WORK. PRIOR TO BEGINNING ANY
TION ACTIVITY, THE OUTER LIMITS OF THE CONTRACTOR'S WORK AREA
BE CLEARLY MARKED BY USING STAKES, PAINT, OR FLAGGING.

EARING AND GRUBBING DEBRIS ACCUMULATION WILL BE PROPERLY
ED OF IN A LAWFUL MANNER.

TED TRENCH MATERIAL WILL BE PLACED UPSLOPE FROM THE
ATION WHENEVER POSSIBLE. SILT FENCE WILL BE INSTALLED ALONG
LOPE TOE OF SOIL PILES.

EXCAVATIONS WILL BE OPEN ONLY LONG ENOUGH TO PROPERLY
L AND INSPECT ALL UNDERGROUND FACILITIES IN ACCORDANCE WITH
ABLE SPECIFICATIONS

EAS REQUIRING INTERIM OR FINAL STABILIZATION MUST BE ADDRESSES
72 HOURS OF COMPLETION OF DISTURBANCE. AREAS UTILIZING
ATIVE STABILIZATION MUST BE SEEDED/PLANTED IN SUFFICIENT TIME TO
NATE BY OCTOBER 15 OF EACH YEAR. SEEDING WILL BE ACCOMPLISHED
GH THE USE OF HYDROSEEDING TECHNIQUES OR CONVENTIONAL SEEDING
ULCHING AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS AND
NS E AND F OF THIS NARRATIVE.

TOCKPILES ARE TO BE SEEDED AND MULCHED IF THEY ARE TO REMAIN
ORE THAN 72 HOURS.

TIME WILL SEDIMENT BE ALLOWED TO LEAVE THE SITE AND ENTER
ONWEALTH WATERS.

RATED EROSION AND SEDIMENTATION WILL BE LIMITED BY STABILIZING
ISTURBED AREAS AS SOON AS POSSIBLE AND BY KEEPING THE AMOUNT
STURBED AREA TO A MINIMUM

NTATION CAUSED BY CONSTRUCTION WILL BE CONTAINED BY SILT
S AND OTHER TEMPORARY EROSION AND SEDIMENT POLLUTION CONTROL
RES. GRASS WILL BE SEEDED AND MAINTAINED IMMEDIATELY AFTER
GRADING OF ANY AREA.

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LETION OF STABILIZATION, ALL UNNECESSARY OR UNUSABLE CONTROL
RES AND FACILITIES SHALL BE REMOVED, THE AREAS SHALL BE GRADED
THE SOILS SHALL BE STABILIZED

&SC PLAN MUST BE IMPLEMENTED PRIOR TOO, DURING AND AFTER EACH
DISTURBANCE ACTIVITY. THE PROJECT SITE SHALL AT ALL TIMES BE
ABLE FOR INSPECTION BY AUTHORIZED EMPLOYEES OF THE DEPARTMENT
NVIRONMENTAL PROTECTION (PADEP) OR THE BRADFORD COUNTY
ERVATION DISTRICT. THE E&SC PLAN SHALL ALWAYS BE AVAILABLE AT
CONSTRUCTION SITE.

ARTHMOVING ACTIVITIES

CTION ACTIVITIES

R SHALL NOTIFY THE BRADFORD COUNTY CONSERVATION DISTRICT AT
SEVEN (7) DAYS BEFORE BEGINNING EARTHMOVING ACTIVITIES,
DING CLEARING AND GRUBBING.

ULE CONSTRUCTION SO THAT GRADING OPERATIONS CAN BEGIN AND
AS QUICKLY AS POSSIBLE

LY MARK THE LIMITS OF DISTURBANCE, OR CONTRACTOR'S WORK AREA,
FLAGS, SIGNS, ETC.

N OF FALLS CREEK (SITE 1) AND PASSIVE WETLAND TREATMENT SYSTEM

ULE CONSTRUCTION ACTIVITIES DURING DRY WEATHER CONDITIONS
EVER POSSIBLE

RUCT PERMANENT STORMWATER INTERCEPTOR CHANNELS 'A' AND 'B'
THE NORTHERN AND SOUTHERN PERIMETERS OF THE CONSTRUCTION
STABILIZE THE CHANNELS WITH RIP RAP LININGS AS SPECIFIED IN THE
RWAY SCHEDULE PROVIDED ON DRAWING NO. 5

L TEMPORARY SANDBAG DAM WITHIN THE EXISTING DRAINAGE CHANNEL

POINT NEAR THE EXISTING
PUMPING TO DEWATER THE EXISTING DRAINAGE CHANNEL TO AN ELEVATION WHERE A CONSTANT POOL ELEVATION WILL BE MAINTAINED NEAR THE SOURCE OF THE AMD DISCHARGE BEHIND THE TEMPORARY SANDBAG DAM

ONCE PUMPING ACTIVITY HAS ALLOWED COMPLETE DEWATERING OF THE EXISTING DRAINAGE CHANNEL TO OCCUR, CONSTRUCT A TEMPORARY SANDBAG DAM TO ELEV. 1902.00 UPSTREAM OF THE EXISTING CULVERT UNDER FALLS CREEK ROAD TO INTERCEPT ANY RESIDUAL DRAINAGE FROM WITHIN THE CONSTRUCTION AREA. CONTINUE PUMPING TO MAINTAIN UPSTREAM POOL AT DISCHARGE ON DOWNSTREAM SIDE OF SANDBAG DAM

ANY DRAINAGE ACCUMULATED WITHIN THE CONSTRUCTION AREA BETWEEN THE TEMPORARY SANDBAG DAMS MUST BE PUMPED THROUGH A SEDIMENT REMOVAL POND. LOCATION SHOWN ON DRAWING No. 3. CONSTRUCT AS SHOWN ON THE DETAIL PROVIDED ON DRAWING No. 9

5 CONSTRUCT PERMANENT AMD BYPASS OUTLET STRUCTURE AND 12" PVC AMD BYPASS PIPE. PROVIDE A MINIMUM COVER OF 1 FOOT OVER THE PIPE AT ALL TIMES. EXTEND PIPE OUTLET THROUGH SANDBAR DAM

6 ONCE THE 12" PVC AMD BYPASS PIPE HAS BEEN INSTALLED, PLACE FILL FOR THE EMBANKMENT BETWEEN THE DETENTION POND AND CELL #1. PROTECT THE DETENTION POND SIDE OF THE EMBANKMENT WITH AN 8" THICK TOP LAYER OF R-3 RIP RAP UNDERLAIN BY GEOTEXTILE FABRIC. EXTEND THE RIP RAP EMBANKMENT PROTECTION FROM THE BOTTOM OF THE SLOPE UP TO THE INVERT OF THE EMERGENCY SPILLWAY.

UPON COMPLETION OF THE DETENTION POND EMBANKMENT, DISCONTINUE PUMPING OPERATIONS AND REMOVE THE TEMPORARY SANDBAG DAM, ALLOWING THE AMD DISCHARGE TO BE DIRECTED UNDER THE CONSTRUCTION AREA THROUGH THE 12" PVC BYPASS PIPE

7 CONSTRUCT AMD PASSIVE WETLAND TREATMENT CELLS 1 THROUGH 4

- i. STRIP AND STOCKPILE TOPSOIL IN THE AREA SHOWN ON THE PLANS. INSTALL EITHER SILT FENCE OR STRAW BALES AROUND THE DOWNSLOPE SIDE OF THE STOCKPILE AS SHOWN IN DETAIL E-2 PROVIDED ON DRAWING NO 9.
- ii. EXCAVATE EXCESS MATERIAL AS NECESSARY TO SHAPE THE TREATMENT CELLS TO THE FINISH GRADES SHOWN ON THE PLANS. STOCKPILE EXCESS MATERIAL AT A LOCATION DETERMINED BY THE OWNER.
- iii. INSTALL 40 MIL LLDPE CELL LINER SYSTEMS, 4" SLOTTED PVC LEACHATE COLLECTION LATERALS, 8" PVC LEACHATE COLLECTION HEADERS AND BYPASS PIPES.
- iv INSTALL AASHTO NO. 57 LIMESTONE. LINE CELL EMBANKMENTS WITH R-3 RIP RAP. INSTALL SPENT MUSHROOM COMPOST AND PLANT WITH WETLAND SPECIES

8 UPON COMPLETION OF CONSTRUCTION OF AMD PASSIVE WETLAND TREATMENT CELLS 1 THROUGH 4, EXECUTE THE FOLLOWING:

- i. REMOVE THE TEMPORARY SANDBAG DAM UPSTREAM OF THE CULVERT UNDER FALLS CREEK ROAD
- ii. CLOSE THE GATE VALVE ON THE INLET END OF THE 12" PVC AMD BYPASS PIPE, FLOODING AND STARTING THE TREATMENT SYSTEM.

CONSTRUCTION OF LONG VALLEY RUN (SITE 2) AMD PASSIVE WETLAND TREATMENT SYSTEM

1 SCHEDULE CONSTRUCTION ACTIVITIES DURING DRY WEATHER CONDITIONS WHENEVER POSSIBLE

2 CONSTRUCT PERMANENT STORMWATER INTERCEPTOR CHANNEL 'C' ALONG THE NORTHERN PERIMETER OF THE CONSTRUCTION SITE, CONNECTING THE DISCHARGE END OF THE CHANNEL TO THE EXISTING AMD DISCHARGE DRAINAGE CHANNEL. STABILIZE THE CHANNEL WITH A RIP RAP LINING AS SPECIFIED IN THE WATERWAY SCHEDULE PROVIDED ON DRAWING NO. 5.

3 CONSTRUCT AMD PASSIVE WETLAND TREATMENT CELLS 1 AND 2.

- i. STRIP AND STOCKPILE TOPSOIL IN THE AREA SHOWN ON THE PLANS. INSTALL EITHER SILT FENCE OR STRAW BALES AROUND THE DOWNSLOPE SIDE OF THE STOCKPILE AS SHOWN IN DETAIL E-2 PROVIDED ON SHEET NO. 9 OF THE DRAWINGS.
- ii. EXCAVATE EXCESS MATERIAL AS NECESSARY TO SHAPE THE TREATMENT CELLS TO THE FINISH GRADES SHOWN ON THE PLANS. STOCKPILE EXCESS MATERIAL AT A LOCATION DETERMINED BY THE OWNER
- iii. PARTIALLY CONSTRUCT AMD INFLOW CHANNEL 'D' TO A POINT WHERE MINIMUM EXCAVATION WILL BE REQUIRED TO COMPLETE THE CHANNEL TO CONNECT TO THE EXISTING SOURCE OF AMD DISCHARGE. STABILIZE THE CHANNEL PERIMETER WITH RIP RAP AS SPECIFIED IN THE WATERWAY SCHEDULE PROVIDED ON SHEET NO. 5 OF THE DRAWINGS.
- iv INSTALL 40 MIL LLDPE CELL LINER SYSTEMS, 4" SLOTTED PVC LEACHATE COLLECTION LATERALS, 8" PVC LEACHATE COLLECTION HEADERS AND BYPASS PIPES. CONSTRUCT AMD DISCHARGE CHANNEL 'E'. LINE CHANNEL PERIMETER WITH RIP RAP AS SPECIFIED IN THE WATERWAY SCHEDULE PROVIDED ON SHEET NO. 5 OF THE DRAWINGS.
- v. INSTALL AASHTO NO. 57 LIMESTONE. LINE CELL EMBANKMENTS WITH R-3 RIP RAP. INSTALL SPENT MUSHROOM COMPOST AND PLANT WITH WETLAND SPECIES.

4 UPON COMPLETION OF CONSTRUCTION OF AMD PASSIVE WETLAND TREATMENT CELLS 1 AND 2, EXECUTE THE FOLLOWING.

- i. COMPLETE CONSTRUCTION OF AMD INFLOW CHANNEL 'D' BY BREACHING THE CONNECTION TO THE EXISTING AMD DISCHARGE CHANNEL. STABILIZE THE REMAINING PORTION OF THE CHANNEL WITH RIP RAP AS SPECIFIED IN THE WATERWAY SCHEDULE ON SHEET NO. 5 OF THE DRAWINGS.
- ii. PLACE FILL WITHIN THE EXISTING AMD DISCHARGE CHANNEL TO REDIRECT THE AMD DISCHARGE INTO THE TREATMENT SYSTEM, FLOODING AND STARTING THE TREATMENT SYSTEM.

E. TEMPORARY CONTROL MEASURES AND FACILITIES

1 SILT FENCE

- a. SILT FENCES WILL BE PLACED AS SHOWN ON THE PLAN TO INTERCEPT THE STORMWATER AND FILTER THE RUNOFF BEFORE IT LEAVES THE CONSTRUCTION SITE.
- b. SILT FENCE IS NOT PERMITTED IN ANY AREA OF CONCENTRATED FLOWS SUCH AS DITCHES, SWALES OR CHANNELS.
- c. ROCK FILTERS TO BE PLACED AT EACH LOW POINT IN SILT FENCE RUNS.
- d. INSTALL SILT FENCE IN ACCORDANCE WITH THE DETAILS AS SHOWN ON THE DRAWINGS.
- e INSPECT SILT FENCES AT LEAST ONCE A WEEK AND AFTER EACH RAINFALL EVENT. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.
- g THE REMOVED SEDIMENT IS TO BE USED FOR ON SITE GRADING. SEEDED AND MULCHED.
- h. ALL UNDERCUTTING OR EROSION OF THE TOE ANCHOR WILL BE REPAIRED IMMEDIATELY WITH COMPACTED BACKFILL MATERIALS.
- i. ADHERE TO MANUFACTURER'S RECOMMENDATIONS FOR REPLACING SILT FENCE DUE TO WEATHERING.
- j. AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PERMANENTLY STABILIZED, REMOVE ALL FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS, BRING THE DISTURBED AREA TO GRADE AND STABILIZE.

2. TEMPORARY VEGETATIVE COVER

- a. SOW ANNUAL RYE GRASS (PENN DOT FORMULA E) AT A RATE OF 10 POUNDS PER 1000 SQUARE YARDS BY BROADCASTING, DRILLING, OR HYDRAULIC APPLICATION. COVER GRASS SEED WITH 1/4" OF SOIL USING SUITABLE EQUIPMENT.
- b AFTER SEEDING, MULCH WITH HAY OR STRAW AT A RATE OF 3 TONS PER ACRE
- c. MULCHING, WITHOUT SEEDING, IS TO BE USED AS AN INTERIM STABILIZATION CONTROL DURING NON-GROWING SEASONS OF THE YEAR

3. ROCK FILTERS

- a. ROCK FILTERS WILL BE PLACED AS DIRECTED BY THE ENGINEER AND AT EACH LOW POINT IN SILT FENCE RUNS.
- b. INSPECT ROCK FILTERS AND CHANNELS FOR DAMAGE AFTER EACH STORM EVENT.
- c. ROCK FILTERS WILL BE CLEANED OR REPLACED WHEN CLOGGED WITH SEDIMENTS. STONE MATERIALS MUST BE WASHED COMPLETELY FREE OF ALL FOREIGN MATERIAL OR NEW ROCK IS TO BE USED TO REBUILD THE DAM. IF STONES ARE WASHED, ENSURE THAT SEDIMENT-LADEN RUNOFF FROM THE WASHED MATERIAL DOES NOT LEAVE THE SITE.
- d. SEDIMENT ACCUMULATIONS REMOVED FROM BEHIND THE FILTERS ARE TO BE USED ON SITE FOR GRADING
- e. ADD ROCK TO THE FILTERS AS NEEDED TO MAINTAIN DESIGN HEIGHT AND CROSS SECTION. REPAIR ALL DAMAGE TO ROCK FILTERS AND CHANNELS IMMEDIATELY

F. PERMANENT CONTROL MEASURES AND FACILITIES

1. ROCK RIP RAP

- a. RIPRAP-LINED CHANNELS AND OUTFALLS TO BE CONSTRUCTED TO THE DIMENSIONS SHOWN ON THE DRAWINGS.
- b. ROCK RIPRAP WILL BE PLACED TO THE FULL COURSE THICKNESS INDICATED ON THE DRAWINGS IN ONE CONTINUOUS OPERATION. OPERATIONS WHICH CAUSE SEGREGATION OF THE MATERIALS WILL NOT BE PERMITTED.
- c INSPECT RIPRAP-LINED CHANNELS AND OUTFALLS AFTER EACH HEAVY RAINFALL EVENT. IMMEDIATELY MAKE ALL NEEDED REPAIRS TO PREVENT FUTURE DAMAGE.
- d. REPLACE ANY STONES WHICH HAVE BEEN DISLODGED AND REPAIR ANY ERODED AREAS WITH ADDITIONAL RIPRAP.

2. VEGETATIVE COVER

- a. REFER TO THE TECHNICAL SPECIFICATIONS FOR SITE PREPARATION, SOIL SUPPLEMENT MATERIALS, SEEDING RATES, AND SEEDING MIXTURES.
- b. INSPECT SEEDED AREAS AFTER EACH RAINFALL EVENT. ERODED AREAS ARE TO HAVE THE TOPSOIL REPLACED, SEED RESOWN AND MULCH REAPPLIED AND ANCHORED.

3. MULCH

- a. MULCH WILL BE APPLIED OVER SEEDED AREAS NO LATER THAN 48 HOURS AFTER SEEDING.
- b. SPREAD MULCH IN A TOTAL COVERAGE AT A DEPTH NOT LESS THAN 1-1/2" NOR MORE THAN 3".

G MAINTENANCE/CONTRACTOR'S RESPONSIBILITIES

1 CONTRACTOR SHALL IMPLEMENT THE EROSION AND SEDIMENT POLLUTION CONTROL PLAN IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.

2 ALL EROSION CONTROL FACILITIES MUST BE INSPECTED AND REPAIRED, IF NECESSARY, AFTER EVERY STORM EVENT. SEDIMENT COLLECTED FROM THE EROSION CONTROL STRUCTURES WILL BE PLACED UPSTREAM OF THOSE CONTROLS AND STABILIZED WITH GRAVEL OR RESEEDING.

3 AT NO TIME WILL SEDIMENT BE ALLOWED TO LEAVE THE SITE AND ENTER COMMONWEALTH WATERS.

4 ANY PERMANENTLY SEEDED AREAS THAT BECOME ERODED WILL HAVE THE TOPSOIL REPLACED, THE PROPER VEGETATIVE COVER RESOWN AND MULCH REAPPLIED.

5. THE INTENT OF THIS PLAN/NARRATIVE IS TO INDICATE GENERAL MEANS OF COMPLIANCE WITH THE REQUIREMENTS OF THE RULES AND REGULATIONS OF CHAPTER 102, THE DEPARTMENT OF ENVIRONMENTAL PROTECTION (AS AUTHORIZED UNDER THE CLEAN STREAMS LAW). IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO IMPLEMENT THESE METHODS, PLUS ADDITIONAL METHODS, AS MAY BE NECESSARY BECAUSE OF CONDITIONS CREATED BY LOCALIZED SITE CONDITIONS AND/OR CONSTRUCTION PROCEDURES IN ORDER TO ASSURE COMPLIANCE WITH APPLICABLE LAW. IT WILL FURTHER BE THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN ALL EROSION AND SEDIMENT CONTROL FACILITIES SO THAT THEY PERFORM AS REQUIRED BY APPLICABLE LAW.

6. FINES AND RELATED COSTS RESULTING FROM THE CONTRACTOR'S FAILURE TO PROVIDE ADEQUATE PROTECTION AGAINST SOIL EROSION AND FOR ANY VIOLATIONS OF THE CLEAN STREAMS LAW AND THE RULES AND REGULATIONS PROMULGATED THEREUNDER SHALL BE BORNE BY THE CONTRACTOR.

7. THE CONTRACTOR SHALL DEVELOP A PREPAREDNESS, PREVENTION, AND CONTINGENCY (PPC) PLAN IN ACCORDANCE WITH 25 PA CODE SECTION 101.3 FOR OPERATIONS THAT DISCHARGE STORMWATER FROM CONSTRUCTION ACTIVITIES

NO.	DATE	REVISION	APPR

SUBMITTED
William C. Lazar 7/23/96
PROJECT

APPROVED
DIRECTOR, BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES [illegible]

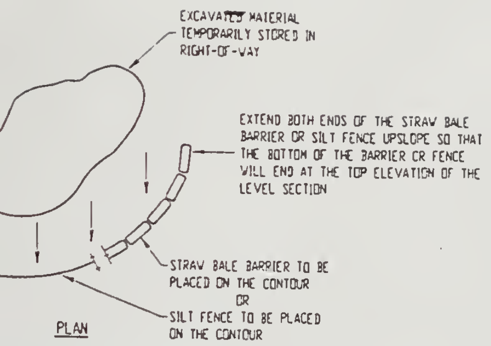
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

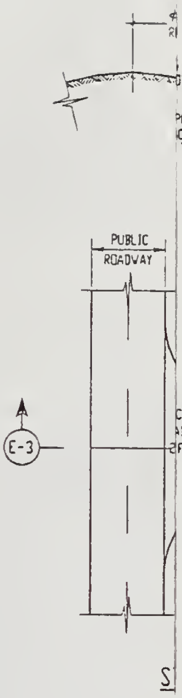
ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK
FRANKLIN TWP. BRADFORD CO

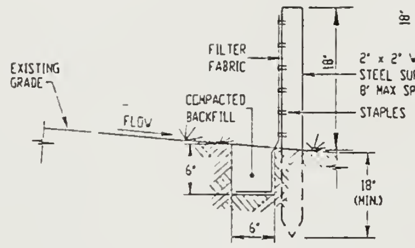
GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

EROSION & SEDIMENT
CONTROL - NARRATIVE



SION PROTECTION
STOCKPILED MATERIAL (E-2)



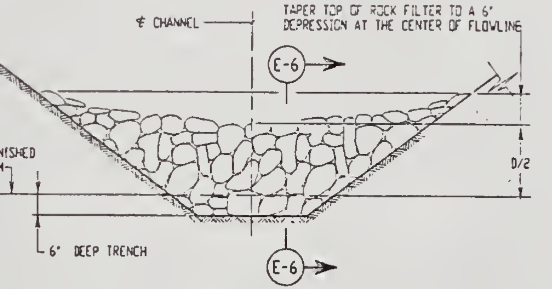


STANDARD SILT FENCE

CED SILT FENCE WHERE SHOWN ON PLAN, FOR FENCE HIGHER
ABOVE GROUND, OR ANY HEIGHT FENCE INSTALLED
FILLS OR EXTREMELY LOOSE DISTURBED SOILS.

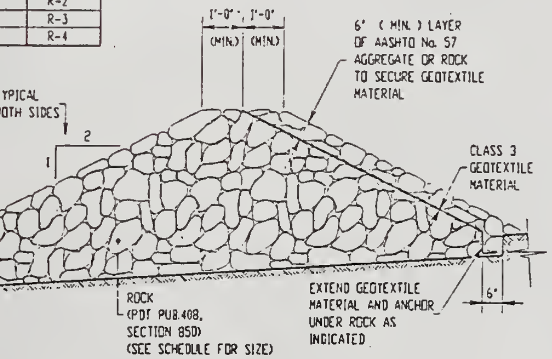
SILT FENCE (E-5)

S


℄ CHANNEL
TAPER TOP OF ROCK FILTER TO A 6"
DEPRESSION AT THE CENTER OF FLOWLINE
E-6
NISHED
D/2
6" DEEP TRENCH
E-6

END VIEW

ROCK SIZE	
	NSA No.
	R-2
	R-3
	R-4



SECTION (E-6)

ROCK FILTER (E-6)

NO.	DATE	REVISION	APPR

SUBMITTED
7/23/96
PROFESSIONAL

APPROVED
DIRECTOR-BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES SMYERS

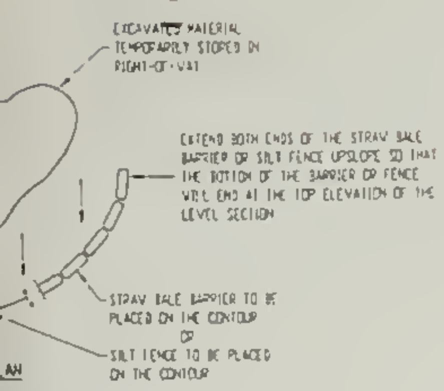
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NO. AMD 08(3295)101.1

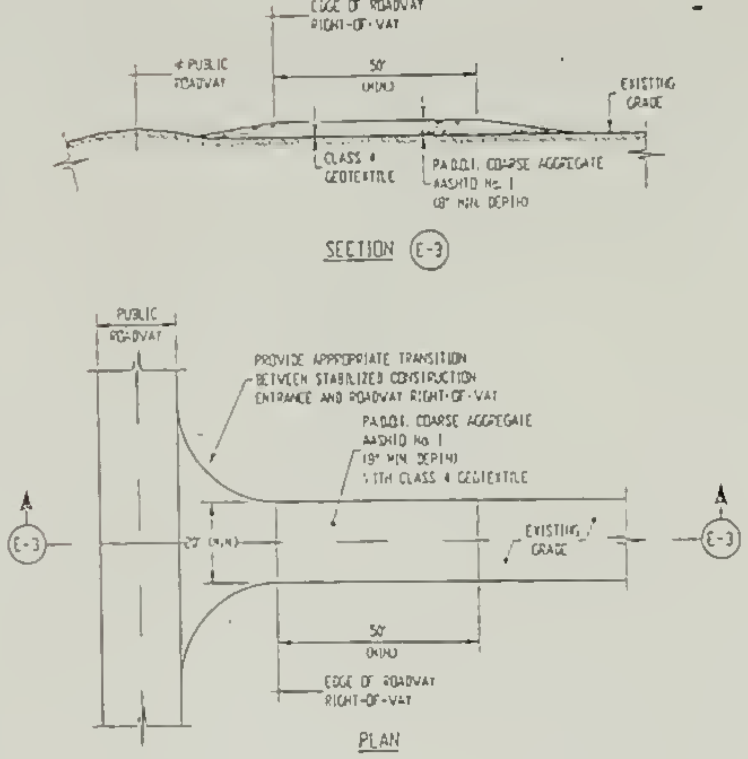
ACID MINE DRAINAGE
ABATEMENT PROJECT
FALLS CREEK
FRANKLIN TWP. BRADFORD CO.

GANNETT FLEMING, INC.
ENGINEERS AND PLANNERS
P.O. BOX 67100 HARRISBURG, PA

EROSION & SEDIMENT CONTROL - DETAILS


EXCAVATED MATERIAL TEMPORARILY STORED IN RIGHT-OF-WAY
EXTEND BOTH ENDS OF THE STRAW BALE BARRIER OR SILT FENCE UPSLOPE SO THAT THE BOTTOM OF THE BARRIER OR FENCE WILL END AT THE TOP ELEVATION OF THE LEVEL SECTION
STRAW BALE BARRIER TO BE PLACED ON THE CONTOUR OR SILT FENCE TO BE PLACED ON THE CONTOUR
LAN

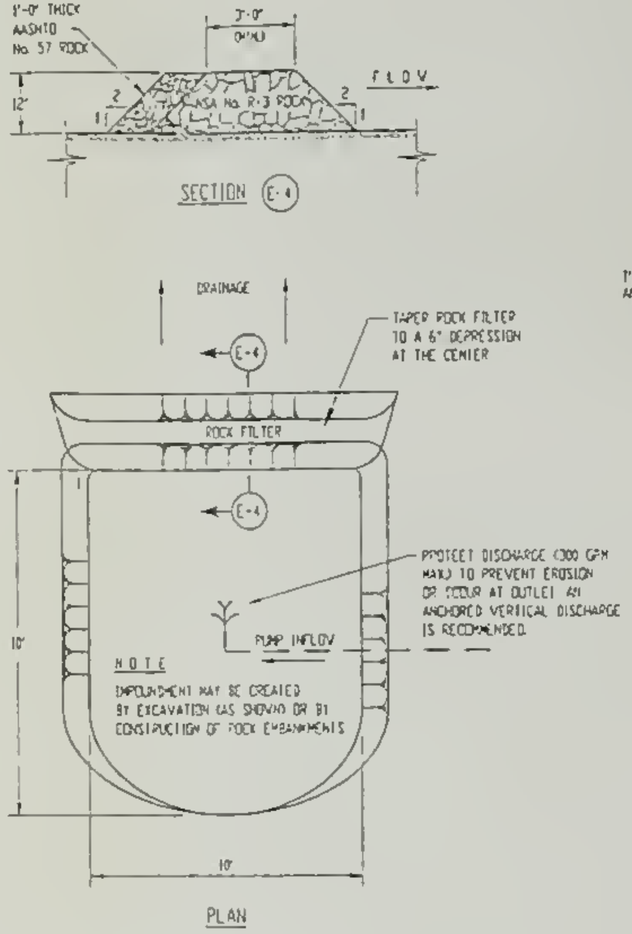
ROTECTION
ILED MATERIAL (E-2)


EDGE OF ROADWAY RIGHT-OF-WAY
℄ PUBLIC ROADWAY
50' (MIN)
EXISTING GRADE
CLASS 4 GEOTEXTILE
PA.D.O.T. COARSE AGGREGATE AASHTO No. 1 (8" MIN. DEPTH)
PUBLIC ROADWAY
PROVIDE APPROPRIATE TRANSITION BETWEEN STABILIZED CONSTRUCTION ENTRANCE AND ROADWAY RIGHT-OF-WAY
PA.D.O.T. COARSE AGGREGATE AASHTO No. 1 (8" MIN. DEPTH) WITH CLASS 4 GEOTEXTILE
20' (MIN)
EXISTING GRADE
A
E-3
50' (MIN)
EDGE OF ROADWAY RIGHT-OF-WAY

SECTION (E-3)

PLAN

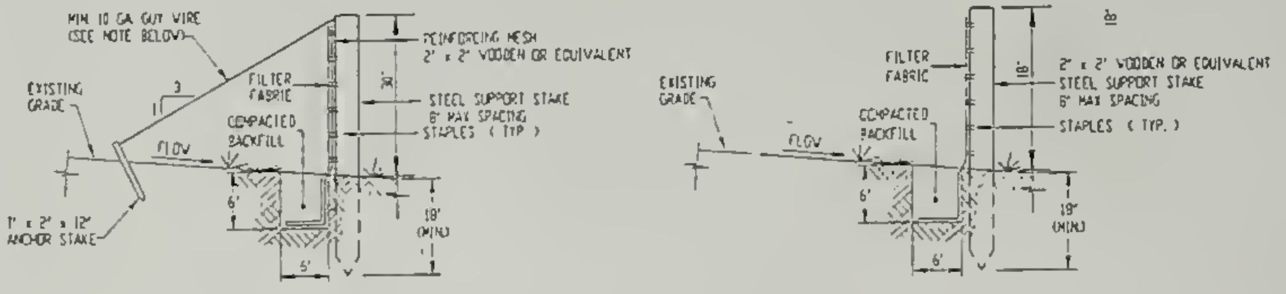
STABILIZED CONSTRUCTION ENTRANCE (E-3)


1'-0" THICK AASHTO No. 57 ROCK
3'-0" (MIN)
FLOW
12"
2
1
NSA No. R-3 ROCK
DRAINAGE
E-4
TAPER ROCK FILTER TO A 6" DEPRESSION AT THE CENTER
ROCK FILTER
PROTECT DISCHARGE (300 GPM MAX) TO PREVENT EROSION OR SCOUR AT OUTLET. AN ANCHORED VERTICAL DISCHARGE IS RECOMMENDED.
PUMP INFLOW
NOTE
IMPOUNDMENT MAY BE CREATED BY EXCAVATION (AS SHOWN) OR BY CONSTRUCTION OF ROCK EMBANKMENTS
10'
10'

SECTION (E-4)

PLAN

SEDIMENT REMOVAL POND FOR PUMPED WATER (E-4)


MIN. 10 GA. GUY WIRE (SEE NOTE BELOW)
EXISTING GRADE
3
1
FILTER FABRIC
COMPACTED BACKFILL
FLOW
REINFORCING MESH
2" x 2" WOODEN OR EQUIVALENT
STEEL SUPPORT STAKE 8' MAX SPACING
STAPLES (TYP.)
30"
6"
18" (MIN)
6"
1" x 2" x 12" ANCHOR STAKE
FILTER FABRIC
EXISTING GRADE
COMPACTED BACKFILL
FLOW
18"
2" x 2" WOODEN OR EQUIVALENT
STEEL SUPPORT STAKE 8' MAX SPACING
STAPLES (TYP.)
6"
18" (MIN)
6"

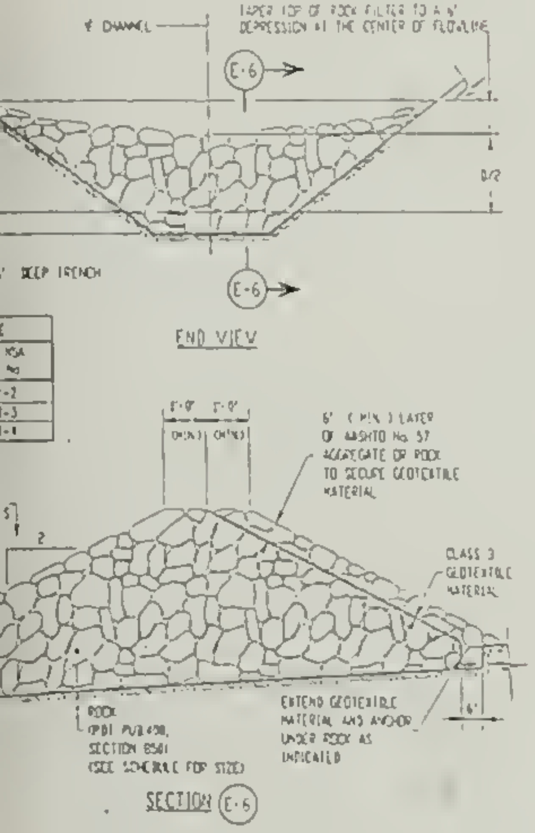
REINFORCED SILT FENCE

STANDARD SILT FENCE

SILT FENCE NOTES

1. PROVIDE REINFORCED SILT FENCE WHERE SHOWN ON PLAN, FOR FENCE HIGHER THAN 18 INCHES ABOVE GROUND, OR ANY HEIGHT FENCE INSTALLED ON UNCOMPACTED FILLS OR EXTREMELY LOOSE DISTURBED SOILS.

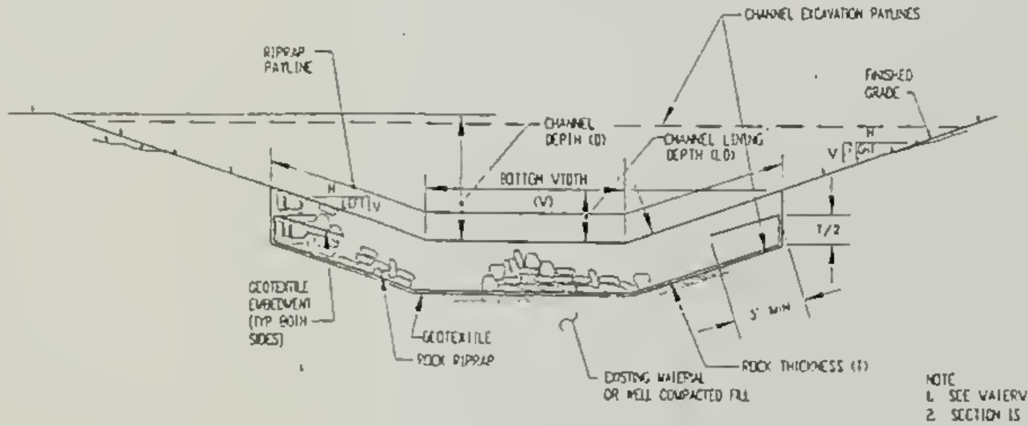
SILT FENCE (E-5)


℄ CHANNEL
TAPER TOP OF ROCK FILTER TO A 6" DEPRESSION AT THE CENTER OF FLOWLINE
E-6
D/2
DEEP TRENCH
NSA
No.
R-2
R-3
R-4
5'-0" (MIN)
5'-0" (MIN)
6" (MIN.) LAYER OF AASHTO No. 57 AGGREGATE OR ROCK TO SECURE GEOTEXTILE MATERIAL
CLASS 3 GEOTEXTILE MATERIAL
2
ROCK (PDT PUB 408, SECTION 850) (SEE SCHEDULE FOR SIZE)
EXTEND GEOTEXTILE MATERIAL AND ANCHOR UNDER ROCK AS INDICATED
6"

END VIEW

SECTION (E-6)

ROCK FILTER (E-6)


RIPRAP PAYLINE
CHANNEL EXCAVATION PAYLINES
FINISHED GRADE
CHANNEL DEPTH (D)
CHANNEL LINING DEPTH (LD)
BOTTOM WIDTH (W)
H
V
T/2
GEOTEXTILE EMBEDMENT (TYP BOTH SIDES)
GEOTEXTILE
ROCK RIPRAP
EXISTING MATERIAL OR WELL COMPACTED FILL
3' MIN
ROCK THICKNESS (T)

NOTE
1. SEE WATERWAY SCHEDULE FOR CHANNEL PARAMETERS.
2. SECTION IS FACING DOWNSTREAM.

GEOTEXTILE FILTER
TYPICAL TRAPEZOIDAL
ROCK-LINED CHANNEL (TZR) (E-19)
NO SCALE

NO	DATE	REVISION	APPR

SUBMITTED
7/23/96

APPROVED
DIRECTOR BUREAU OF ABANDONED MINE RECLAMATION

PAUL E. PAUL
WILLIAM JAMES [illegible]

COMMONWEALTH OF PENNSYLVANIA
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CONTROL - DETAILS